Compressed Air Magazine

JANUARY 1945

BIRTH OF STEEL FOR PLANE PARTS

100 tons of metal from an electric furnace being poured into ingot molds.

VOLUME 50 • NUMBER 1

NEW YORK • LONDON

New Life For Dead Ends

Put some fresh air in those confined working areas—and you'll put new life into the men who are working there.

At 110°F. a man's working efficiency is only about 10%. In foul air, his efficiency is equally low, and there's a chance he'll become ill. Fresh, cool air costs so little, it's a shame to lose so much working efficiency for lack of it.

You'll find a Coppus Blower designed for almost any type of dead end you may have — for underground cable manholes, furnaces, tanks, tank cars, etc., or around hot jobs like coke ovens or steam processes. They are also handy for cooling and drying equipment or materials in process.

Each one is portable . . . designed for the convenience of the workers and maximum use of air . . . built to Coppus "Blue Ribbon" specifications regarding materials and construction so as to take plenty of rough service.

For specific information, check and mail the coupon. Address Coppus Engineering Corp., 201 Park Avenue, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEET'S CATALOG, CHEMICAL ENGINEERING CATALOG and REFINERY CATALOG.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fusilages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME.....

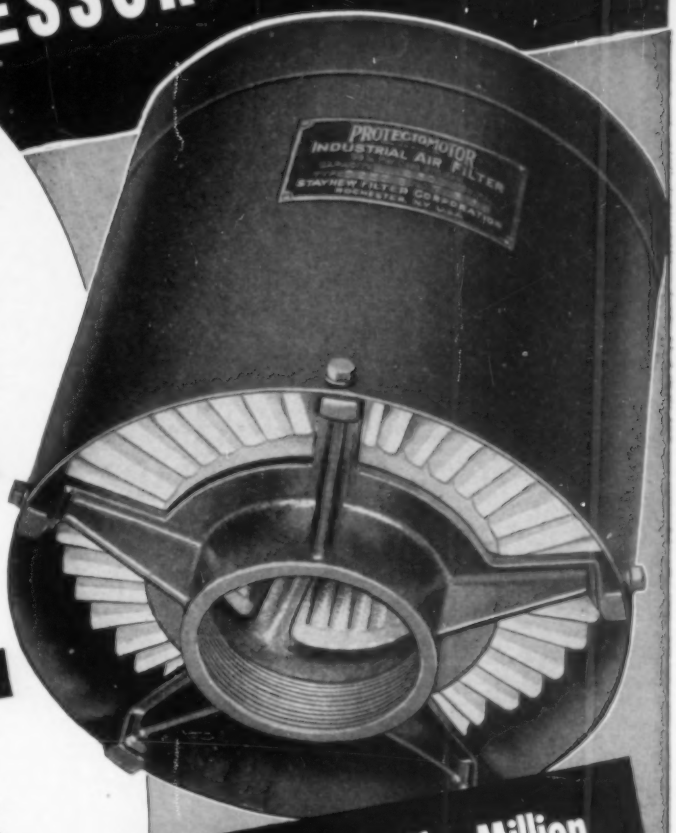
COMPANY.....

ADDRESS.....

CITY.....

(Write here any special ventilating problem you may have).

WHY PROTECTOMOTOR INTAKE FILTERS ARE BEST FOR AIR COMPRESSOR USE



★ HIGH EFFICIENCY WHEN INSTALLED

Protectomotor Air Filters for internal combustion engines and compressors feature dry-type filtering media. These media are selected to fit particular installation conditions. They have been scientifically tested in the laboratory and proven by field use. Used in combination with the patented Radial Fin Insert Construction, they provide highest operating efficiency.

★ INCREASED EFFICIENCY WITH USE

Protectomotor filtering efficiency actually *increases* when dust begins to accumulate on the surface of the media, since this forms a precoating or filter-aid of the very material which is being handled.

★ LOW RESTRICTION TO AIR FLOW

Protectomotors at maximum ratings offer initial resistance to air flow of less than ½" of water. Since the exclusive Radial Fin Construction provides a maximum of filtering area, this resistance is held to a minimum throughout the life of the filter.

★ SERVICING SELDOM NECESSARY

The Protectomotor is a masterpiece of simple, rugged construction. There are no moving parts, no reservoirs, no liquids. The extremely large active filtering area reduces cleaning to an absolute minimum for any given set of conditions. When required, cleaning is quickly and easily accomplished by vacuum, compressed air, or washing.

★ POSITIVE PROTECTION ★ ★ ★

Inherent characteristics of the dry-type filtering media provide *positive* protection. Performance is *not* dependent upon periodic renewal of viscous coatings or other filter aids. Ideal for dust storm areas.

★ EFFICIENT AT HIGH OR LOW TEMPERATURES

As the filtering media used are of the dry-type, peak efficiency is maintained under all atmospheric conditions. There is no oil to evaporate at high temperatures or to congeal at low temperatures.

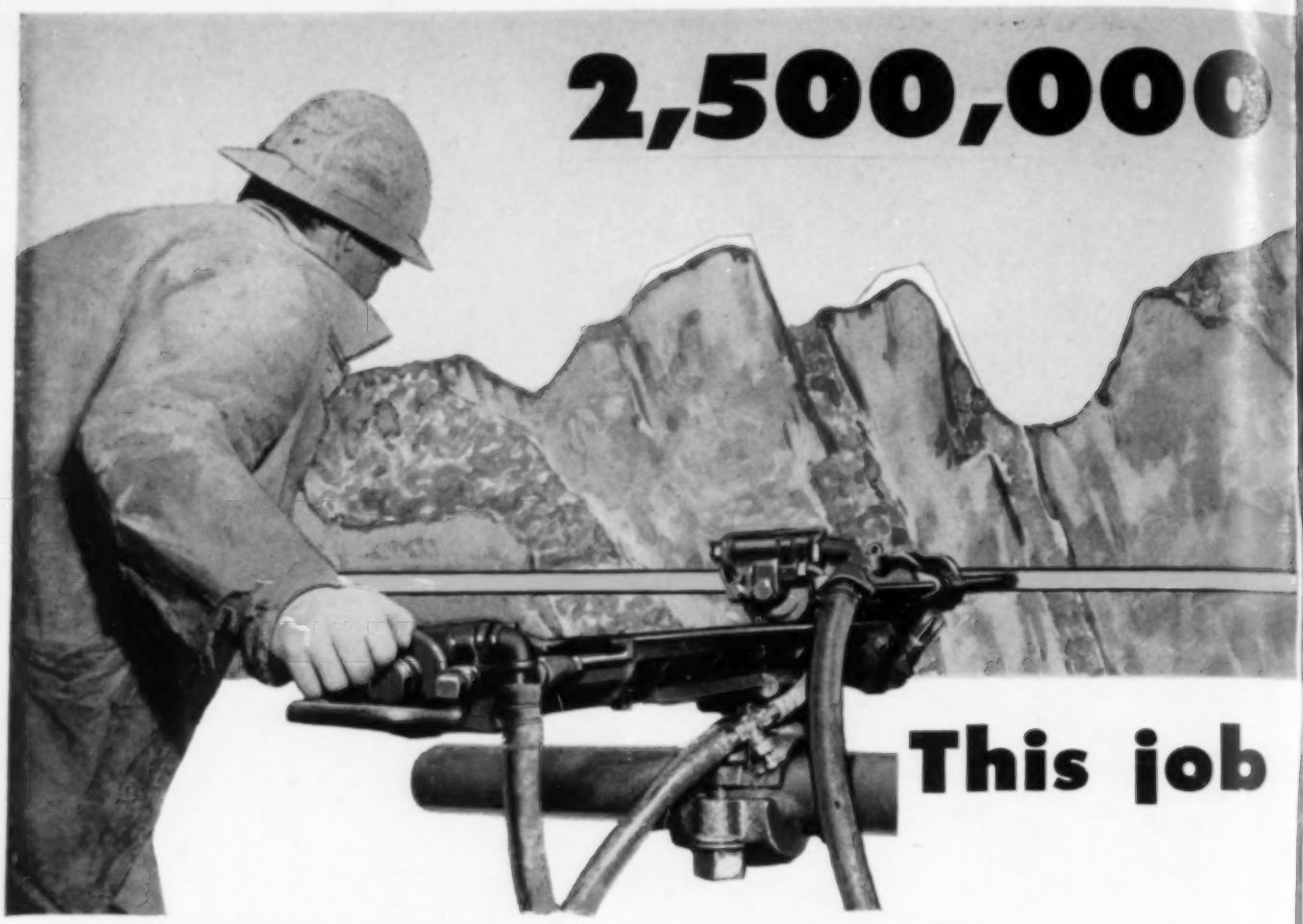
More than Half a Million Installations on Internal Combustion Engines and Compressors since 1920

Write for Catalog and Data Blank for Free Analysis of your Requirements

Radial Fin Construction

STAYNEW PROTECTOMOTOR FILTERS

DOLLINGER CORPORATION
(Formerly Staynew Filter Corp.)
1 Centre Pk., Rochester 4, N. Y.



2,500,000

This job

With the completion of the 13-mile Alva B. Adams Tunnel, originally called the Continental Divide Tunnel, a new high in overall rock drilling performance has been written into the records.

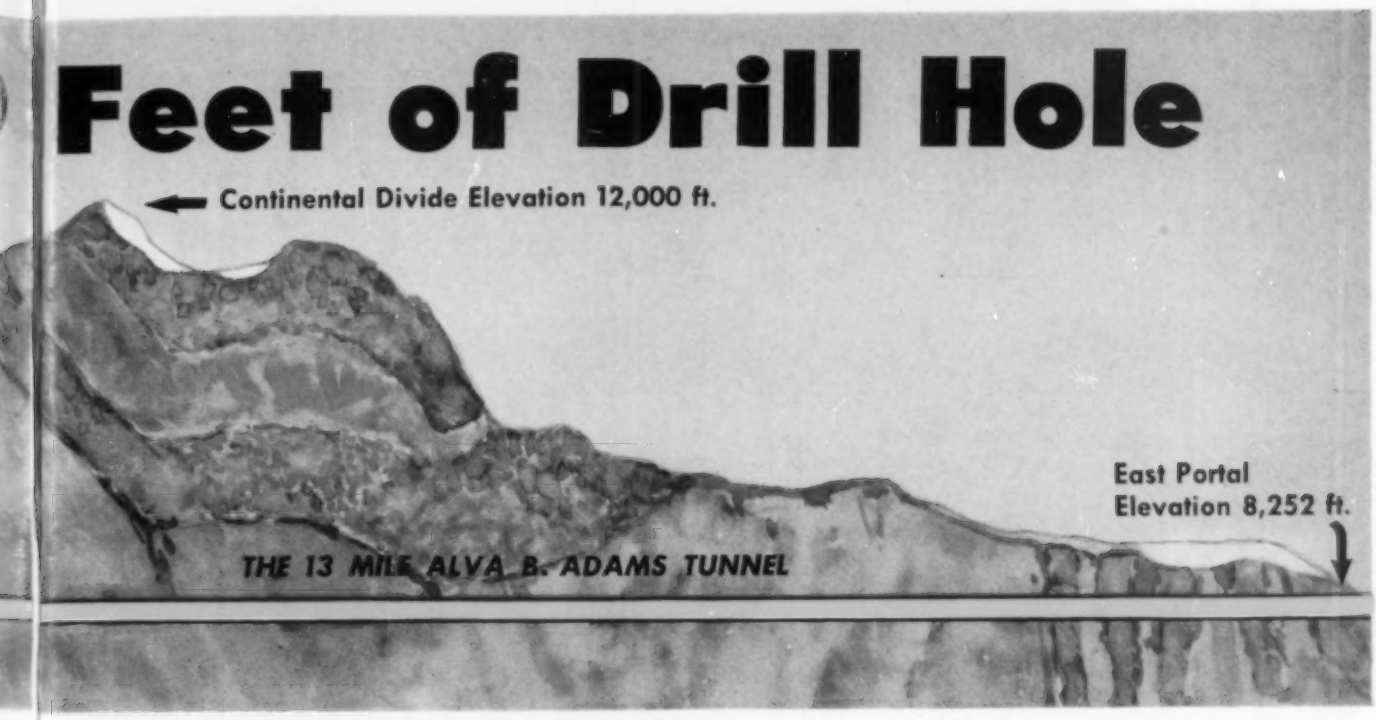
DA-35 Power-Feed Drifters (3½-inch bore) drove all but the first 6600 feet of this tunnel. They put down approximately 2,500,000 feet of drill hole. Some of these drifters had already seen service in the 6300-foot Treasury Tunnel. Despite this fact, when operations were finished, all the original drills were still in service. Not a single machine was discarded. This record of durability becomes even more remarkable when it is realized that Ingersoll-Rand compressors held the air pressure at the receivers at 125 pounds.

Now let's look at drilling speed. The best single

POWER-FEED ADVANTAGES

1. The Power-Feed reduces drilling time.
2. A sturdy, trouble-free motor and gearing arrangement insures a dependable feeding action.
3. The Power-Feed attached to the back end of the shell, provides safety and freedom from shock.
4. One size of Power-Feed is used for all I-R Drifters. This simplifies the stocking of repair parts.
5. A wide range of feeding power is attained by 40 different throttle positions.

Feet of Drill Hole



proves DA-35 Durability and Drilling Speed

day's advance in one heading in this 11¾-foot bore was 74 feet. The best monthly record was 1624 feet. Drilling speed such as this enabled the crews to complete this 13-mile tunnel in three years of actual working time. The performance was so noteworthy that it caused one official to state that only a few years ago the driving of this tunnel would have been a ten-years' job.

The steady flow of repeat orders for DA-35 Drifters from many mining men, contractors, and quarry operators, is further proof of the outstanding durability and drilling speed designed into these machines.

See for yourself how these machines will improve your operating picture! Ask your nearest Ingersoll-Rand service branch for full particulars.

OTHER I-R PRODUCTS USED ON THIS PROJECT

COMPRESSORS. Two veteran, belt-driven units furnished 125 pounds pressure 24 hours a day.

JACKBITS. Only 2.83 Jackbits were required for each linear foot of tunnel advance. Each bit was used 7 times.

JACKBIT RECONDITIONING EQUIPMENT. The I-R line consisting of Jackfurnaces, Sharpeners and Jackmills was used at both East and West portals. Each hotmill averaged 850 bits per day.

SUMP PUMPS. These lightweight, portable units delivered the water from the west heading to the main pump station.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • OIL AND GAS ENGINES

5-545

99 Years of Leadership *in making valves for industry*

In a book on Cincinnati, published shortly after the Civil War, the following statement concerning the Wm. Powell Co. appears—"the Company, founded in 1846, manufactures the celebrated "Star" Regrinding Globe Valve, of which over 100,000 are now in use in all parts of the country." Shown at the extreme right is the drawing used in 1865 to get the patent on this valve. The plant in which these valves were being made at that time is shown in the inset.

Today, in modern plant buildings covering many acres, the company is making a complete line of Globe, Angle, Gate, Check, Relief, Y, Non-return and other types of valves in bronze, iron, steel, pure metals and special alloys for corrosion resistance (catalogs on request).

The "Union" Vulcanized Composition Disc Globe Valve shown here is the result of almost a century of scientific advancement and practical experience in making valves—and valves only—for Industry.

The Wm. Powell Co.
Dependable Valves Since 1846
Cincinnati 22, Ohio

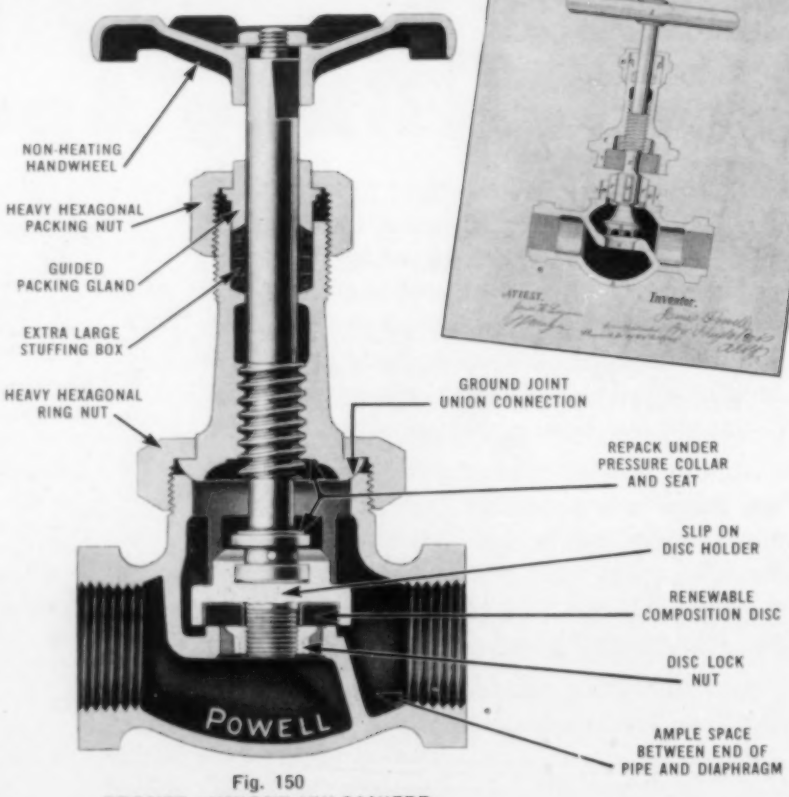


Fig. 150
BRONZE "UNION" VULCANIZED COMPOSITION DISC GLOBE VALVE

POWELL VALVES

HOW TO SOLVE OPERATING PROBLEMS WITH *Correct Lubrication*

Give your Groundbreaker a Break!

WITH GARGOYLE ALMO OIL NO. 3

•

OXIDATION that causes valves to gum up...water that washes oil films off... corrosion and rust that increase repair and replacement expense....

These are the destructive forces that your lubricating oil must fight off to keep your groundbreaker hammering away on wartime schedules.

On this job, Gargoyle Almo Oil No. 3 is proving its exceptional qualities.

This specially refined oil provides high chemical stability to resist oxidation and gumming. It sticks on vital parts, despite the washing action of water, and gives them full protection against corrosion and rust.

You *minimize* maintenance cost and down time. You *get* full speeds and continuous operation for maximum footage.

SOCONY-VACUUM OIL COMPANY, INC.
Standard Oil of N.Y. Div. · White Star Div. · Lubrite Div. · Chicago Div. · White Eagle Div. · Wadhams Div. · Magnolia Petroleum Co. · General Petroleum Corp. of Cal.

GARGOYLE Lubricants

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

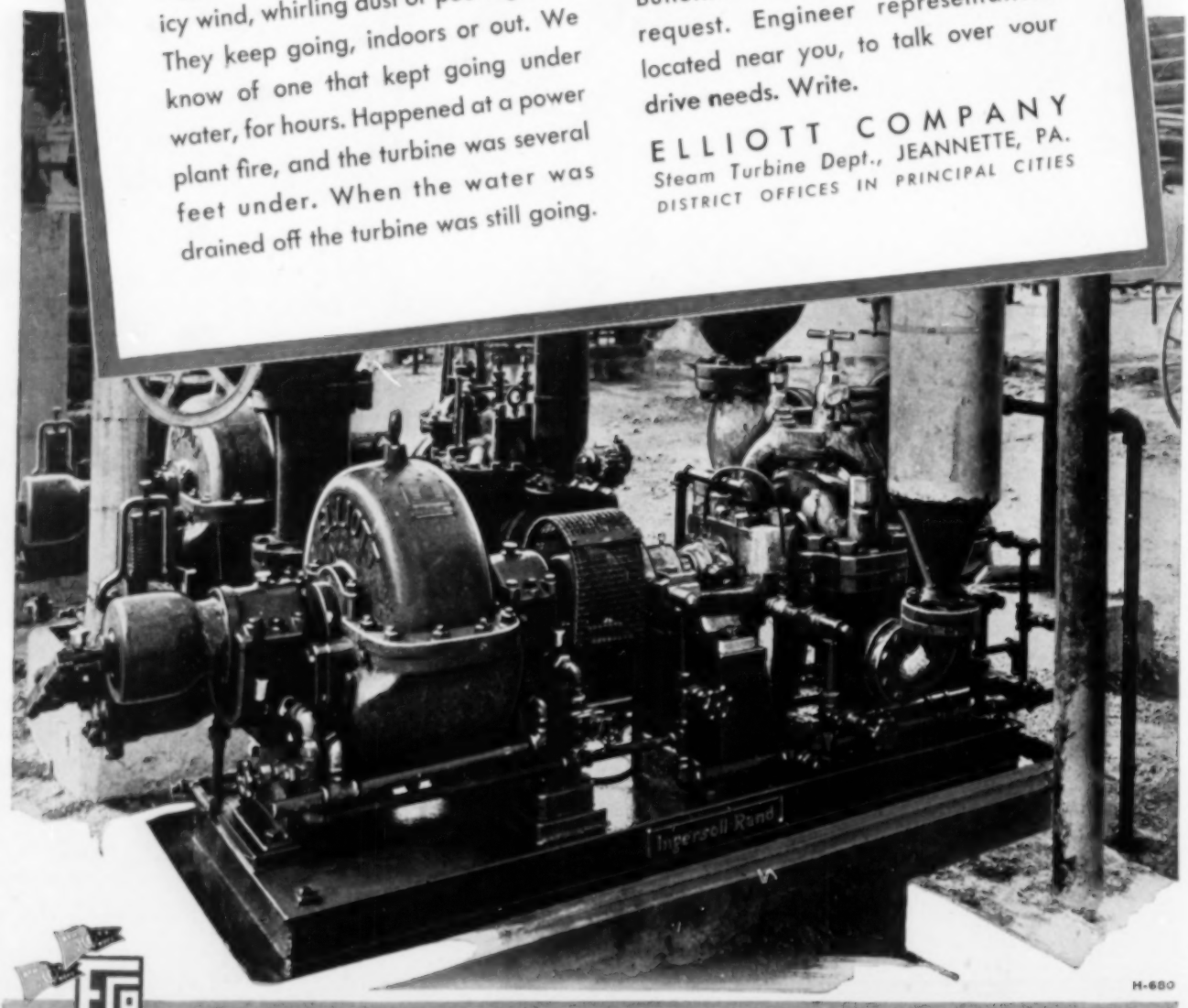
CALL IN SOCONY-VACUUM

"Things never get too tough for an ELLIOTT turbine"

You might say they are brought up rugged. They work in blazing heat or icy wind, whirling dust or pouring rain. They keep going, indoors or out. We know of one that kept going under water, for hours. Happened at a power plant fire, and the turbine was several feet under. When the water was drained off the turbine was still going.

Good turbines for tough jobs. Good turbines for any auxiliary drive job. Types for all needs within broad range. Bulletins that give full details, at request. Engineer representatives located near you, to talk over your drive needs. Write.

ELLIOTT COMPANY
Steam Turbine Dept., JEANNETTE, PA.
DISTRICT OFFICES IN PRINCIPAL CITIES



H-680

ELLIOTT Company

STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS • FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES • TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

"The Ultimate in a *Mechanized Quarry*"

Loading rock at the quarry face. Payload is 15 tons. Cedar Hollow Plant of Warner Company, Devault, Pa.

EASTON overhead hoist, electrically operated by remote control, tips 15-ton loads quickly or feeds large rocks one at a time as required.

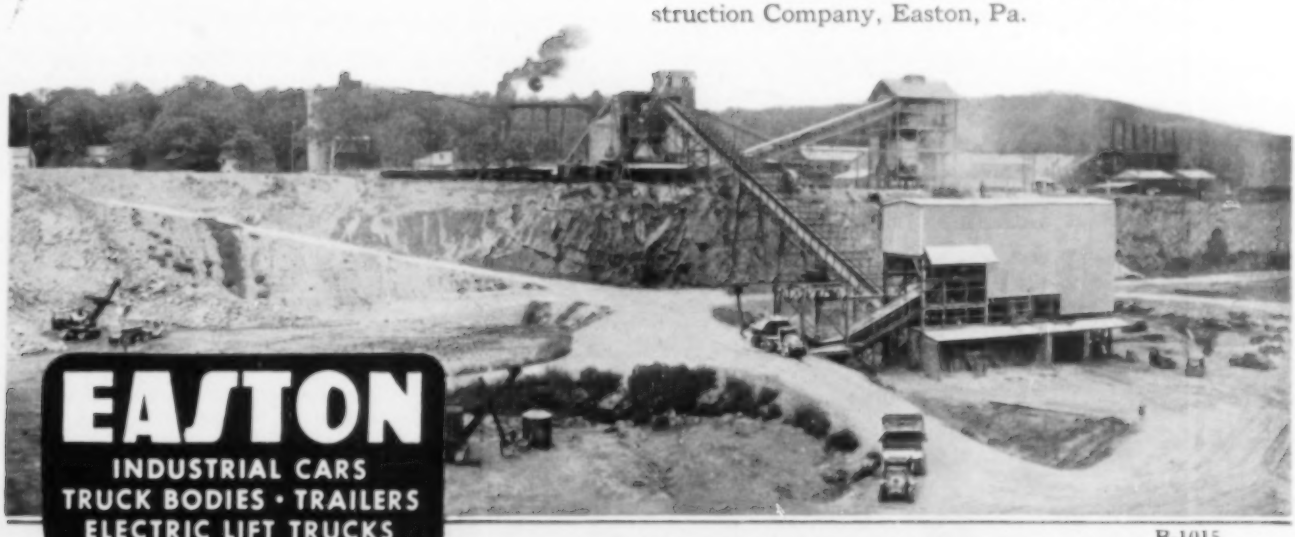
"Day after day the tractor-trailers move from quarry face to primary crusher . . . quietly, smoothly, and with no evidence of strain on either men or equipment."

"After six months' operation our records show no lost time charged to this system of conveyance . . . one which we consider to be the ultimate in a mechanized quarry operation."

This statement by Mr. Wilson, General Superintendent of the Lime Division, comes after conversion to EASTON Model TR-10 Semi-Trailers.

Semi-trailer haulage really pays dividends!

Write to: Engineering Counsel, Easton Car & Construction Company, Easton, Pa.



EASTON

INDUSTRIAL CARS
TRUCK BODIES • TRAILERS
ELECTRIC LIFT TRUCKS

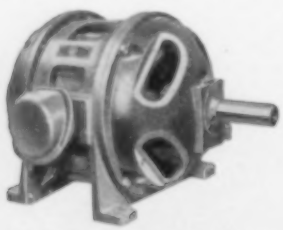
B-1015

BUILDING A MOTOR TO DELIVER A HURRICANE

Driving a 400 mile-an-hour super-hurricane through a plane-testing tunnel takes plenty of horsepower . . . more than anybody had ever packed into a wound-rotor induction motor before. To do it, Westinghouse designed and built the world's largest. Its 40,000 horsepower spins two 16-blade fans standing nearly 40 feet high—weighing 197 tons. The motor itself weighs 125 tons, stands 15 feet high and you could drive a small truck through the stator you see above. Cooling it takes 85,000 cubic feet of air per minute.

This is just another example of Westinghouse ability to build motors—motors designed to do specific jobs. It's the kind of engineering skill back of every Westinghouse motor you buy—special or standard.

For war work or postwar reconversion, take full advantage of this ready-to-use experience. You'll solve your drive problem quicker and know the motor will fit the job—whether it is a fractional or 40,000 horsepower. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. J-21294



This is only one of the many Westinghouse general purpose motors available in standard and special enclosures. Features include choice of sealed sleeve or ball bearings; Tuffernell insulation; Balanced rotor; rigid one-piece frame; die-cast rotor; radio-frequency tested insulation.

Westinghouse Motors

PLANTS IN 25 CITIES ... OFFICES EVERYWHERE

DAYTON V-BELT DISTRIBUTOR SOLVES HIGH NOISE-LEVEL PROBLEM

The Lowe Brothers Company, nationally known paint manufacturer, seeks to control every factor contributing to high noise level. The lubricated drives on many of their machines had become noisy and required undue maintenance.

—So Again they called their Dayton V-Belt Distributor

He had often studied and helped them solve many power-transmission problems. For example, he provided 6 Dayton V-Belts for an overhead, out-of-the-way vertical drive, to operate this modern, high-speed paint grinding mill. Its 25 H.P. motor now turns 1200 lb. steel rolls at 345 R.P.M's and graduated speeds...with little belt noise and at very low upkeep. "They give us no trouble at all," says their maintenance engineer, "but mostly we've found Daytons are so especially quiet running."

You can easily get the same efficient help! You simply call the Dayton V-Belt Distributor. He will help you quickly convert to Dayton V-Belts that are smooth-running, hard-gripping and especially long-lasting.

The Technical Excellence of Dayton Rubber gives you V-Belts pronounced unsurpassed both in mechanically correct design and in quality of construction. Call your Dayton V-Belt Distributor today.

THE DAYTON RUBBER MFG. CO.
The World's Largest Manufacturer of V-Belts
DAYTON 1, OHIO

Dayton Rubber Export Corp., 38 Pearl Street, New York, N.Y., U. S. A.
Cable Address: WIDBLOCO

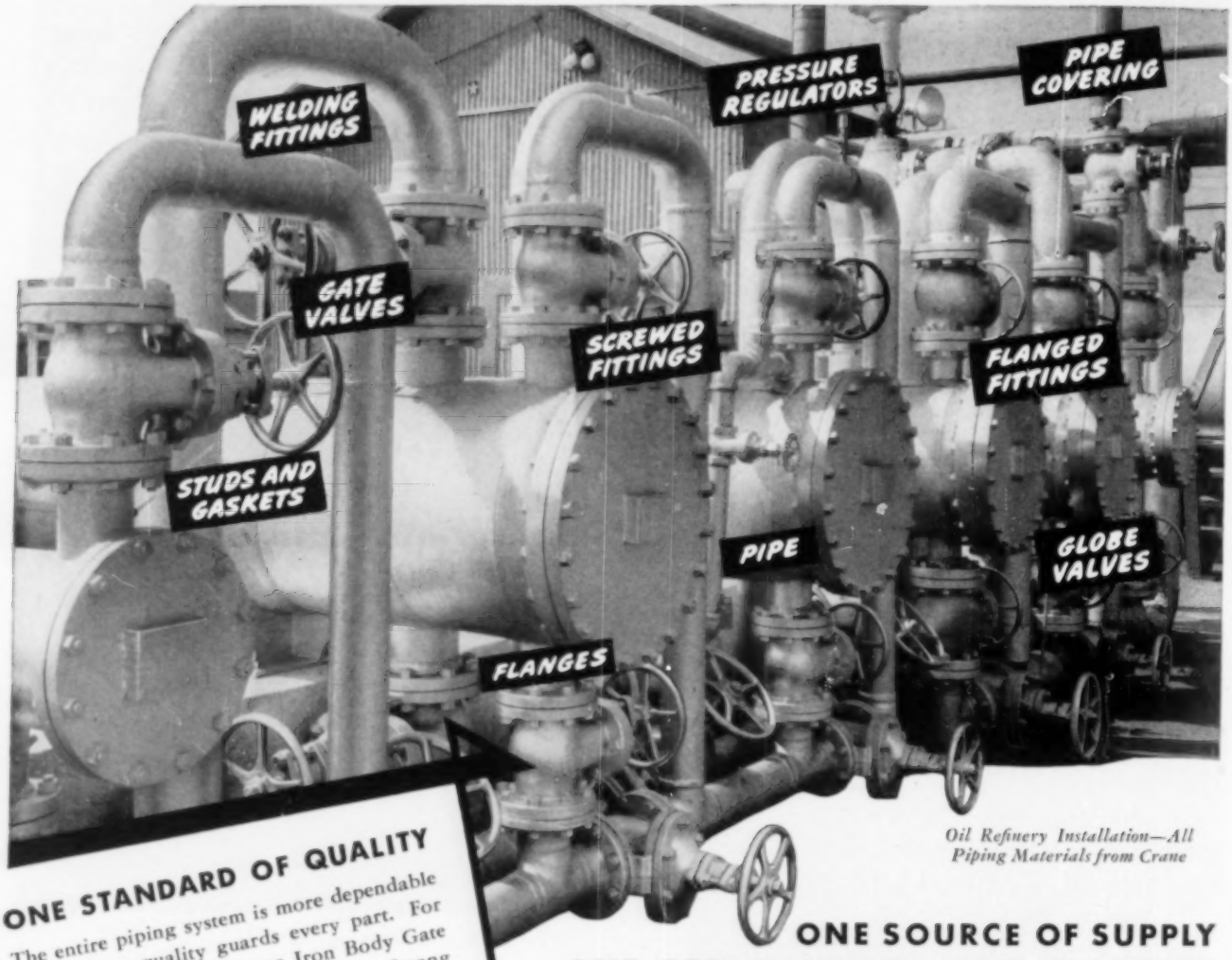
CALL YOUR DAYTON V-BELT DISTRIBUTOR OR WRITE DIRECT

V-Belts by Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

The Mark Of Technical Excellence In Synthetic Rubber

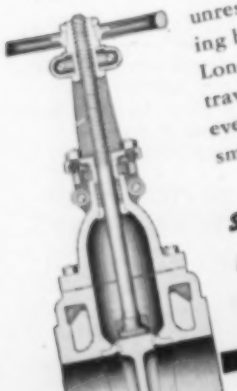
Call Crane for All Materials for Any Piping System



Oil Refinery Installation—All Piping Materials from Crane

ONE STANDARD OF QUALITY

The entire piping system is more dependable when Crane quality guards every part. For example, here's what Crane Iron Body Gate Valves add to pipe line performance. Strong body sections resist severest line stresses. Straight-through ports permit unrestricted flow. A deep stuffing box lengthens packing life. Long disc guides keep disc travel true, while finest design in every part insures long life, and smooth, trouble-free service.



STANDARD
IRON BODY
WEDGE GATE VALVES

ONE SOURCE OF SUPPLY
ONE RESPONSIBILITY FOR ALL PARTS

Catching up with war-deferred replacements—from ordering to installation of parts—is simplified by using Crane *complete* piping materials service. From one single source—your Crane Branch or Wholesaler—you get everything you need for any application. Valves, fittings, pipe, fabricated assemblies, piping accessories—in brass, iron and steel—in all pressure classes.

In all piping items the Crane line gives you the world's greatest selection. With one responsibility guarding the quality of all materials, you are better assured of good installations. At the same time you are getting the full benefit of Crane Co.'s 90-year experience and leadership in meeting industry's piping needs. CRANE CO., 836 S. Michigan Avenue, Chicago 5, Illinois.

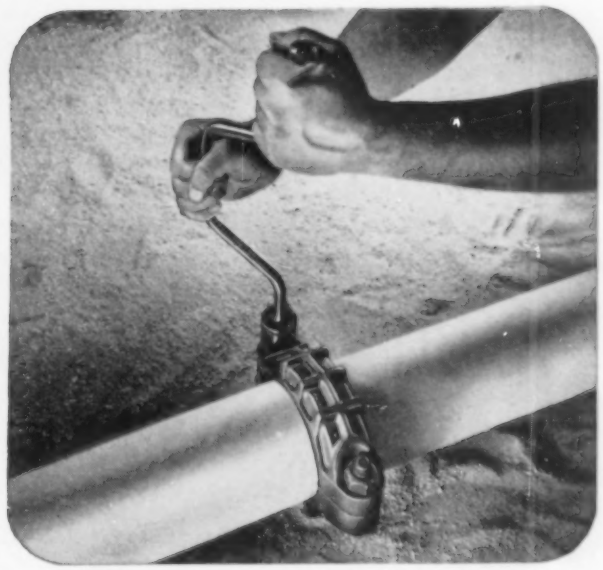
90 YEARS OF PROGRESS 1855 1945

Branches and Wholesalers Serving All Industrial Areas

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Take 2 lengths of Standard grooved pipe



. . . add one Victaulic Coupling . . .

and you've got a leak-tight, flexible, expansion joint,

QUICKER THAN ANY OTHER METHOD

Save man hours, save money! One tool does all the work, a speed socket wrench. Coupling centers automatically on pipe and the housing floats in pipe end grooves . . . allowing freedom of movement for temperature changes, eliminating need for accurate alignment of pipe lines. With Victaulic there's a UNION at every joint . . . and every joint is mechanically locked, positive, slip-proof, leak-tight under pressure or vacuum.

If you have piping problems, you'll find all the answers pertaining to your industry in our new Victaulic Catalog and Engineering Manual. Write on your firm's letterhead for your copy today. VICTAULIC COMPANY OF AMERICA, 30 Rockefeller Plaza, New York 20, N. Y.; Victaulic Inc., 727 West 7th Street, Los Angeles 14, California; Victaulic Company of Canada, Ltd., 200 Bay Street, Toronto.

VICTAULIC

Reg. U. S. Pat. Off.

SELF-ALIGNING PIPE COUPLINGS AND FULL-FLOW FITTINGS

OIL MINING MARINE MUNICIPAL INDUSTRIAL

RockerShovel

Two machines are averaging 150 cans per day. As you know they use only one man to a loader for loading, switching and tramming.

Mr. [redacted] was extremely pleased with the operation and stated, "Consider it the best piece of equipment we have ever bought."

Remarks

The Superintendent, of this property, told me they have handled over 30000 tons with their loader. Mr. [redacted] one of the owners, said the loader is liked better every day.

It is remarkable, but this loader has been operating now for four years without a single major repair on it. It is still o.k. for operation without any work actually having to be done on it. It has taken plenty of punishment.

Called back at [redacted] Mine to see what they were doing with their 21. To date the best they have done is 446 cans. As yet they have not had enough "muck" to keep it going a full shift.

Remarks

Started two loaders in [redacted] Mine. That will give them four machines in this one operation.

Mr. [redacted], the underground superintende told me Friday that they are loading for 6¢ cents a can.

Remarks

Looked over loader 1125 today. This loader is still in good shape and has given them no trouble.

He is certain they can average 500 cans when he can get enough ground broken. He also wants another 21.

Remarks

Our loaders are giving so muc service than the competitive mak they are considering getting rid them and replacing them with Eim

Remarks

when our equipment is used the rate is 85¢ per ft. and in drifts where no mechanical loaders are being used the rate is $2.40 per ft.

"RockerShovel Service" is just one of those extra "no charge" items you get with each RockerShovel. Eimco realizes that customer satisfaction comes only when the loader is doing a "bang-up" job and the only way to be sure the RockerShovel is performing up to standard is to go see.

In all kinds of weather in Alabama, California, Vermont, Washington, and Canada, or wherever mining is done—Eimco Engineers, especially trained in loader service, are on the job. Eimco is interested in the production of each RockerShovel. A report is made on each call and besides helping our Engineer-

Upper right—Drilling of next round can be started while RockerShovel is working. Lower right—Large bore high speed tunnels are loaded out quickly and efficiently. Water does not bother the RockerShovel. Below—Small, crooked drifts in hard rock make exceptionally fast progress when using a Model 128 RockerShovel for loading.

Service

ing department they contain many informative remarks. (See extracts reproduced left).

The RockerShovel doesn't need much attention but the men call anyway — breaking in new operators, smoothing out the track advance, or car switching method and passing along new pointers and tricks they have picked up in similar operations. This service assures the management at the mine of an all around efficient loading operation.

Yes! "RockerShovel Service" is included "N.C."

Is your loader a "RockerShovel?"

Eimco RockerShovel

A-82

EIMCO

THE EIMCO CORPORATION

Executive Offices and Factories: Salt Lake City 8, Utah

Branches: New York, Chicago, El Paso, Sacramento, St. Louis

Yes, Men Make Motors!

NO MACHINE KNOWN can duplicate the skill of Sam Meister, left, of Allis-Chalmers Norwood Works.

Holding an acetylene torch in his right hand, a silver alloy rod in his left, Sam silver-brazes end connections of Allis-Chalmers' "Indestructible Rotor."

Round and round the connections he works — expertly flowing in molten alloy to form a joined structure that can withstand as much heat as though it were a single die-casting.

No machine can do that job — and no machine can fully test how well it is done.

There's only one test . . . wait 5, 10, 15 years and *see.*

And that's the test in which Allis-Chalmers motors have proved over the years that they're *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

• • •

YES, HUNDREDS of Allis-Chalmers men—craftsmen like Sam Meister — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a *friend* . . . and they know that's something no company and its workers can have too many of.

Next time *you* need great motors contact our district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 1730

AC — WE WORK FOR VICTORY — WE PLAN FOR PEACE

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

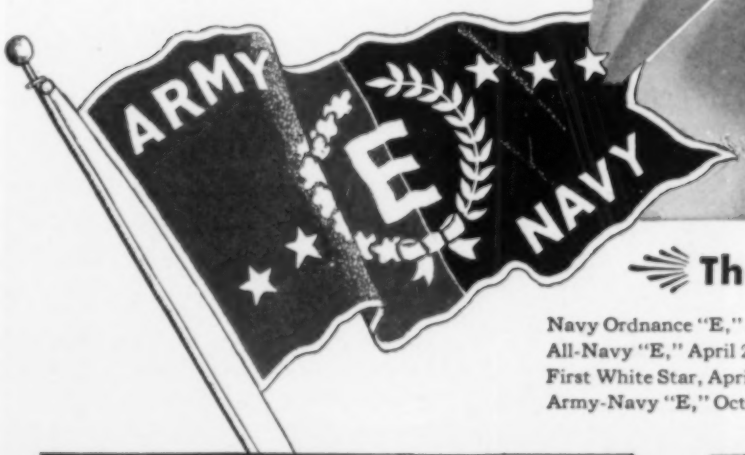
YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

America's Most Significant Production Award . . . .

the 5th White Star comes to National Forge

A "five star plant" denotes the highest possible recognition that can be earned in war material production. And like military precedent, the 5th White Star can only be earned by "coming up through the ranks"— the preceding four White Stars, as well as the basic Army-Navy "E" Awards, have to be a matter of record before a company is in line for the 5th White Star recognition. And to receive the 5th White Star, the original excellence of production has to be maintained — without interruption — for six, successive, six month periods.

The management of National Forge therefore feels it can announce the receipt of the 5th White Star award with pardonable and understandable pride . . . a pride which fully recognizes that it is National Forge workers who have established this unsurpassed record as award winners . . . and also a symbol, we are sure, that there will be no abatement of National Forge efforts in war production as long as the Army and Navy have need of our services.



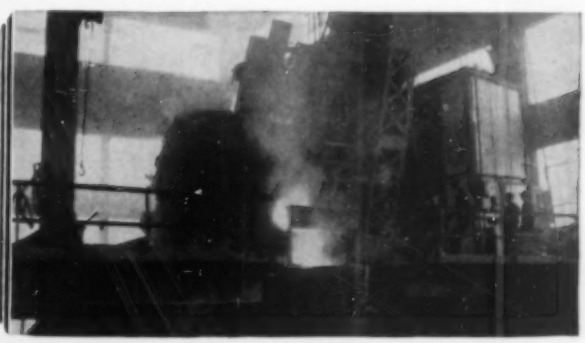
The Record of Awards

Navy Ordnance "E," October 24, 1941
All-Navy "E," April 24, 1942
First White Star, April 24, 1942
Army-Navy "E," October 24, 1942
Second White Star, October 24, 1942
Third White Star, April 24, 1943
Fourth White Star, October 24, 1943
Fifth White Star, October 24, 1944

NATIONAL FORGE
& ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA.
"WE MAKE OUR OWN STEEL"

For Excellence E *in Production*

☆ ☆ ☆ ☆ ☆



For Maximum Production from the Cleaning Room Specify "NORTON RESINOID"
NORTON COMPANY
ALUNDUM
WORCESTER MASS U S A
Two Outstanding Norton Resinoid Wheels for Steel Castings...
A14-O4BL for Floor Stands
A14-P4BL for Swing Frames
These recommendations are based on medium pressure and medium contact. Light pressure or large contact would mean slightly softer wheels while heavy pressure and small contact would call for somewhat harder grades.
In each case you are sure of a snagging wheel that's engineered for its job—special resinoid bond formulae developed by Norton research for foundry grinding plus Alundum abrasive especially selected for snagging work.
There are also Norton Resinoid Wheels of Crystolon abrasive for gray iron and unannealed malleable castings. Call on your Norton abrasive engineer for recommendations.
NORTON COMPANY
Worcester 6, Mass.
W-987
NORTON ABRASIVES

ON THE COVER

THE best steel it is possible to make goes into parts for our fighting aircraft. Because steel from the electric furnace is purer than that produced in any other way, that process is turning out vast quantities of metal these days. Our cover picture shows John Murowski, casting man in the No. 2 Electric Furnace Department of the Carnegie-Illinois Steel Corporation's South Chicago Works, teeming molten steel into hot-top ingot molds from a huge ladle that is moved along the casting line by an overhead traveling crane.

•

IN THIS ISSUE

SINCE the days of the legendary Horatius, bridges have played a big part in warfare. Once it was possible to repulse an enemy invasion by keeping possession of river crossings. This doesn't work today because modern armies carry their bridges with them and throw them across streams with incredible speed. Our leading article describes a late development in Army ponton spans. Note: Pontons and pontoons are identical, but the Army Engineers prescribe the first spelling.

•

TO RESIDENTS along our Atlantic seaboard, Navy blimps have become almost as familiar as airplanes during the past three years. These helium-filled craft have saved many a ship from being torpedoed. Huge hangars are required to house them at their bases, and with steel in short supply, fire-resistant timber has been successfully used in their construction. R. G. Skerrett tells you about it.

•

THERE is a lot of general information about portable air compressors in an article based on a talk given by C. T. Chapman to a group of utilities men. There are also pointers on what type and size of machine will give the best service per dollar expended.

•

MOST people are amateur photographers in some degree. If you have a camera and have tried making portraits and wondered what was the matter with them, you can perhaps find the answer in Edwin H. Jenkins's article. The author operates a portrait studio in Easton, Pa.

Compressed Air Magazine

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EDITORIAL CONTENTS

Span that Stream!—*Robert Clark* 2
Fire-Resistant Hangars for Blimps—*R. G. Skerrett* 5
Portable Air Compressors in Utilities Work—*C. T. Chapman* 10
Why Amateur Portraits Look that Way—*Edwin H. Jenkins* 16
Water for Our Troops 20
The Oriental Fire Piston 22
Dam Built to Resist Earthquakes 23
This and That 24
Editorials—Standardization Problems—Keeping Them Going 25
Granite-Lined Elbows for Pneumatic Conveyors 26
Packaged Coal for Household Use 26
To be Honored by Construction Group 26
Industrial Notes 27

ADVERTISING INDEX

Aircraft Standard Parts Co. 33
Allis-Chalmers Mfg. Co. 16
American Brass Co., The 22
American Hoist & Derrick Co. 33
Audel, Publishers 35
Bird-White Co. 31
Bucyrus-Erie Co. 28
Compressed Air Magazine Co. 29
Conrader Co., R. 31
Cook Mfg. Co., C. Lee 27
Coppus Engineering Corp. 2nd. Cover
Crane Co. 12
Crane Packing Co. 20
Dayton Rubber Mfg. Co., The 11
Dollinger Corporation 3
Easton Car & Construction Co. 9
Eimco Corporation, The 14, 15
Elliott Company 8
Farris Engineering Co. 29
Galland-Henning Mfg. Co. 31
Granton & Knight Co. 38
Hercules Powder Co. 36
Industrial Clutch Co., C.M. Eason 25
Ingersoll-Rand Co. 4, 5, 21, 32, 3rd Cover
New Jersey Meter Co. 37
Koh-I-Noor Pencil Co., Inc. 37
Lebanon Steel Foundry 39
Logan Engineering Co. 33
Maxim Silencer Co. 26
Murphy & Co., Jas. A. 35
National Forge & Ordnance Co. 17
Naylor Pipe Co. 19
Nicholson & Co., W. H. 29
Norgren Co., C. A. 33
Norton Company 18
Powell Co., The Wm. 6
Products Mfg. Co. 37
Socony-Vacuum Oil Co., Inc. 7
Square D Company 35
Terry Steam Turbine Co., The 30
Texas Company, The ..... 4th Cover
Timken Roller Bearing Co., The 24
Victaulic Company of America 13
Vogt Machine Co., Henry 34
Waldron Corp., John 35
Walworth Co. 23
Westinghouse Elec. & Mfg. Co. 10

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PONTON RAFT

Four pneumatic floats—actually a section of a ponton bridge—used as a raft. It is ferrying a truck equipped to lay bridge treadways. Bridge parts are being assembled in the left background.

BRIDGE-BUILDING SCENES

A ponton bridge is normally built of a series of sections such as that shown at the right. This consists of two pneumatic floats with steel treadways supported on saddles. After being made up near the shore, the section is towed to its allotted place in the bridge by a utility boat, or is propelled by an outboard motor. Truck-mounted portable compressors (below) are available for inflating pneumatic pontons to the desired pressure. A specially fitted truck is shown (lower right) laying the final section of steel treadway to complete an M2 pneumatic ponton bridge. This particular type of structure can be used by motorized equipment weighing up to 46 tons. The view at the upper right shows a tank moving ashore from a balk and chess bridge supported by aluminum pontons. Note the hinge span between the bridge proper and the shore trestle.

SPAN THAT STREAM

Robert Clark

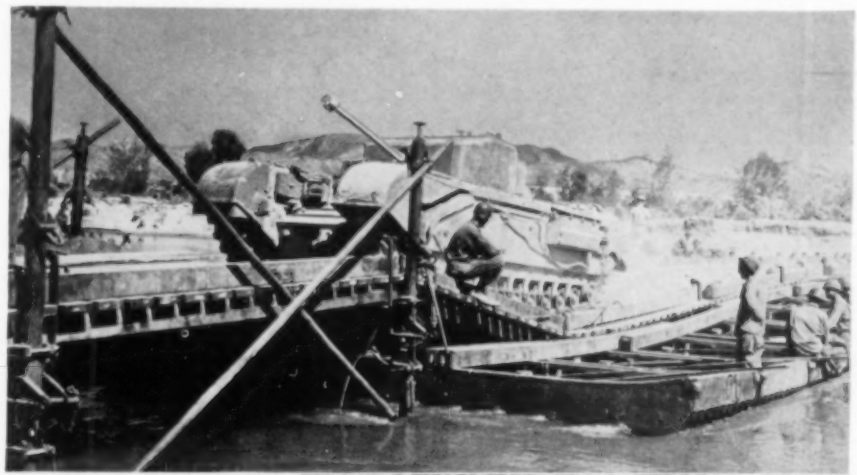
WHEN our armies roll across the north German plain towards Berlin, the retreating Nazi forces will undoubtedly demolish hundreds of bridges that span the many rivers of that rainy country. But it will do them little good, for our Army Corps of Engineers can throw ponton bridges across streams nearly as fast as the Germans can blow up the old ones. And as these military bridges are designed not only for foot soldiers but also to take tanks, trucks, guns, and tractors, little in the way of mechanized equipment need be left behind during the advance.

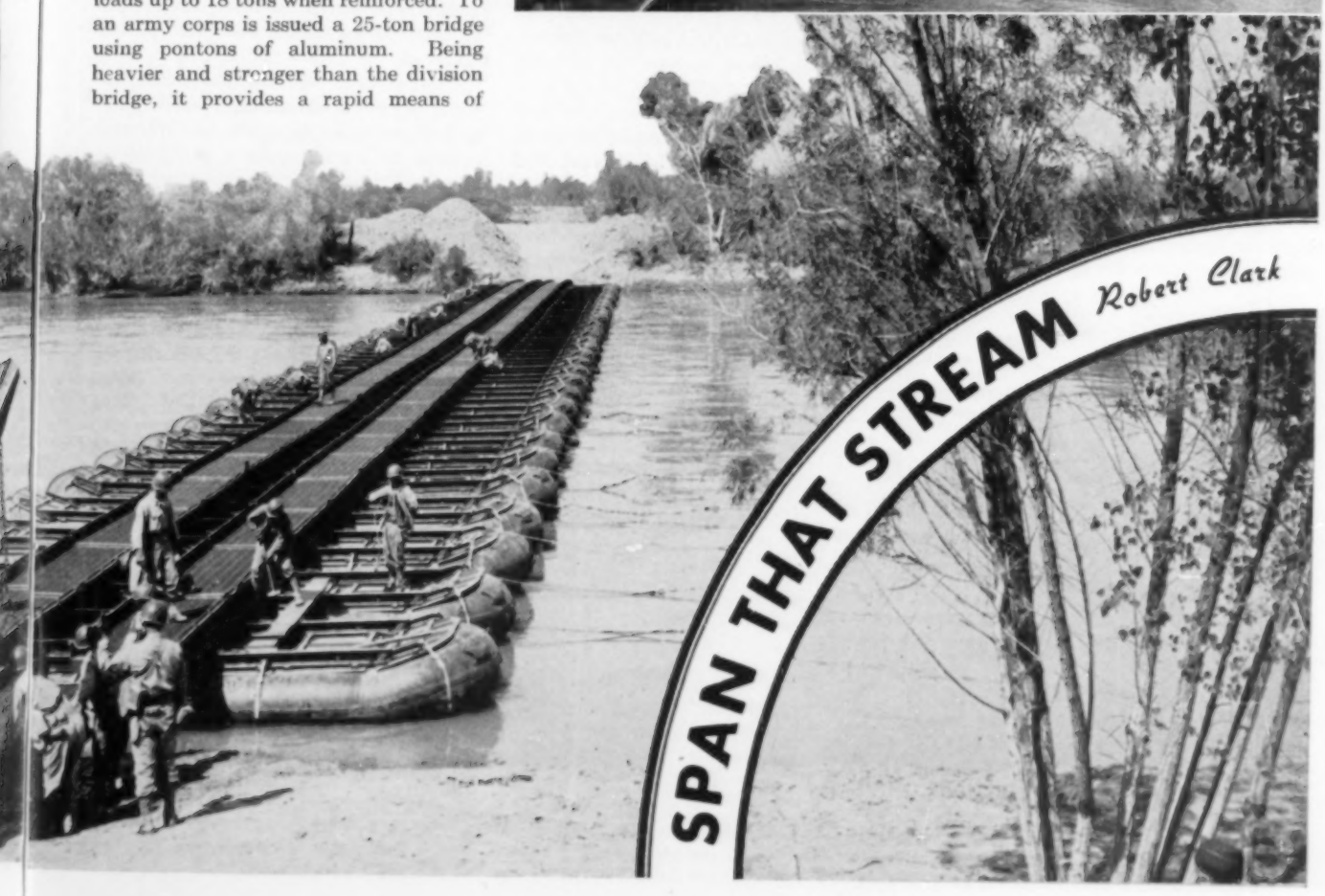
The Germans should know that the American Army is master of stream crossing, for in May, 1919, U. S. Engineers set a world record by building a 1440-foot ponton bridge across the Rhine River at Honnigen, Germany, in the amazing time of 41 minutes!

Most laymen think of a ponton bridge as simply a few scowlike boats anchored in line and covered with planks. But this is far from true. The modern ponton bridge is a masterpiece of design, combining maximum efficiency with minimum equipage. So highly specialized are these bridges that it is possible to assign to each unit of our armed forces a specific bridge company or battalion exact in size and capacity to serve the needs of that unit. An army division, for instance, may have attached to it an "M3 pneumatic ponton bridge" which carries loads up to 18 tons when reinforced. To an army corps is issued a 25-ton bridge using pontons of aluminum. Being heavier and stronger than the division bridge, it provides a rapid means of stream crossing for any military vehicle in the corps.

This Big Bertha among military bridges uses pontons more than 32 feet long, each weighing approximately 2700 pounds and having a maximum displacement of 41,400 pounds. Some idea of the size of such a ponton is obtained from the fact that, when equipped with an outboard motor, it can ferry 100 men with full equipment across a river. When used as floating supports for the completed bridge, these heavy pontons will take anything the army now has or is likely to have—from the heaviest tanks to the most massive ordnance.

But this is for big time; and the pressing need for something more suitable for the smaller force—a bridge that could carry heavy loads and yet not be too unwieldy—has brought about an innovation in ponton bridges. Developed some time before the Japs attacked Pearl Harbor, and continually improved, this stream-crossing equipment uses pneumatic pontons and is known among pontoniers as the "M2 Steel-Treadway Bridge." Designed primarily to carry all vehicles in an armored division, up to and including the medium tank (approximately 34 tons), it was found that by reinforcing the bridge with additional floats its capacity could be increased to accommodate a 46-ton assault tank.





Probably the most important single element of this bridge is its pneumatic ponton. This is composed of a pneumatic float and a saddle. The float itself is 33 feet long, 8 feet 3 inches wide, and 33 inches deep when inflated. It is formed by a perimeter of rubberized-canvas tubing cast in the form of a squeezed doughnut, with a bottom also of rubberized canvas. A detachable tube of the proper diameter fits into the center of the float, increasing its buoyancy when submerged and at the same time giving it added rigidity. So well designed is this "water wing" that, while it weighs only about half a ton and can be rolled up compactly for transportation, it will support nearly 18 tons when blown up. Four air-compressor trucks attached to the outfit are available on a moment's notice to inflate the floats to their proper pressure of about 2 pounds per square inch.

The weight of the roadway formed by the parallel steel treadways, together with the vehicle load on them, is transmitted to the float through the saddle. This consists of a system of steel beams and bearing plates, so designed that it can be "knocked-down" for compactness. Once the saddle is secured to the float, the completed ponton is ready to receive the steel treadways. These form two unbroken strips over the pontons and will accommodate not only narrow-gauge vehicles such as automobiles and trucks but also those of wider gauge, such as tanks.

The effective length of a treadway is 12 feet, with a clear track width of 3 feet 9½ inches. Weighing about a ton each, these steel treadways are fastened together longitudinally by engaging plates and two connecting pins at each joint to form a rigid continuous beam. In some special instances, one pin is left out at a joint, producing a hinge span that allows that section to rise and fall with the stream or tide.

Soldiers in a bridge battalion refer to one ponton with two treadways as a ponton section, and with this basic element a ponton bridge is usually constructed by a method known as "building by parts." (A part consists of one or more sections.) When constructing a ponton bridge in such a manner, the parts are assembled at some convenient spot near shore or up a nearby protected tributary, and each is then floated to its place in the bridge. The number of ponton sections needed to form a part depends on several factors: the necessity for concealment, the speed of the current, the depth of the stream, and the condition of the bottom near the shore.

Since speed, dispersion, and surprise are the three essential elements of a successful bridge crossing, most of the actual building of a floating ponton bridge in a battle zone is done at night. Radioactive luminous markers serve to show the centerline of the bridge and the location of stock piles and personnel. And after months of training, the men of a bridge battalion can construct their ponton bridge almost as fast under cover of darkness as they can in the daytime.

Still another use to which pontons can be put is that of raft building. One pneumatic float with the center tube removed is a passable craft for ferrying personnel with their combat equipment during late phases of an assault crossing. When employed for this purpose, twelve paddlers are placed astride the outside tubes of the float and twelve passengers ride in the center.

In addition, rafts suitable for all loads up to the capacity of the normal M2 steel-treadway floating bridge can be constructed of ponton sections. One advantage of such a raft is that it can load and unload along any ordinary stream bank without the use of landing stages. A 2-ponton raft with an outboard motor attached is most convenient for ferrying personnel, placing anchors, towing bridge parts, reconnaissance, and patrolling.

The headquarters company of an armored engineer battalion usually has available an M2 treadway "ferry set" composed of six floats and saddles, twelve treadways, and other necessary accessories. This equipment can be transported in three 6-ton treadway trucks, and is quickly available for ferrying medium tanks or other heavy vehicles if equipment for an entire M2 bridge is not at hand. By using just four pontons and five pairs of treadways, a raft having a usable roadway of 60 feet is obtained that will also carry one medium tank.

Almost as interesting as the floating pneumatic bridge and ponton-raft construction are the different methods of employing a ferry system using pontons. And like bridge and raft building, different conditions determine which method shall be employed. There is the "flying ferry," for instance. In this case a long line, secured to one bank of the stream, is attached to a ponton raft. By means of bridle lines that keep the raft in a certain position relative to the current, the raft can be made to cross the stream in much the same manner as a child flies a kite—the drag of the water producing a vector of force that sends the raft "flying" back and forth across the river.

Another type of ferry known as the "trail ferry" is often used. With this method, a line is run across the river and secured to both banks. A "bicycle traveler" is rigged on the line, and hauling and maneuver lines are run from this device to the raft. Again, by tilting the raft to take advantage of the current flow, and with the aid of two outboard motors, motive power for crossing the stream is obtained.

But no matter what the crossing situation may be—swift stream or sluggish, deep water or shallow—our army bridge engineers are able to meet it. And even if a streamlined ponton-bridge battalion is not handy, the soldier engineer has been taught to improvise for a successful stream crossing by using whatever is available. Empty oil drums lashed beneath tree trunks that have been cut from a nearby forest will, in an emergency, do for a bridge, while almost anything up to and including an unloaded 2½-ton truck can be ferried across a stream provided it is wrapped in a tarpaulin.

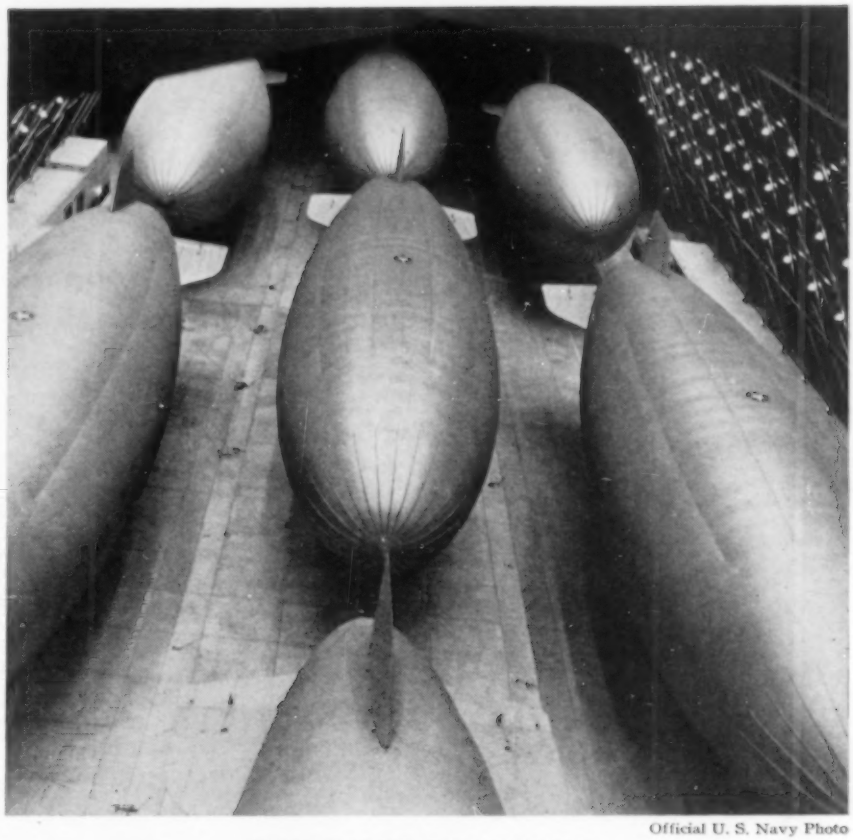
So, regardless of the water barrier encountered, our army engineers are prepared to execute the commanding officer's order: "Span that stream!" For the motto of the pontoniers is *Essayons!*—Let us try!

REPAIRING WASHED-OUT BRIDGE

Combating a swollen river and working in a driving rain, members of an Army Engineer bridge battalion speedily restore a damaged crossing on the Italian front.

Fire-Resistant Hangars for Blimps

R. G. Skerrett



Official U. S. Navy Photo

BLIMPS NESTED IN HANGAR

Seven of the Navy's nonrigid airships housed in one of the great new "docks" on the Eastern coast. The blimps have carried real authority in the campaign to curb the German submarine menace to Allied shipping.

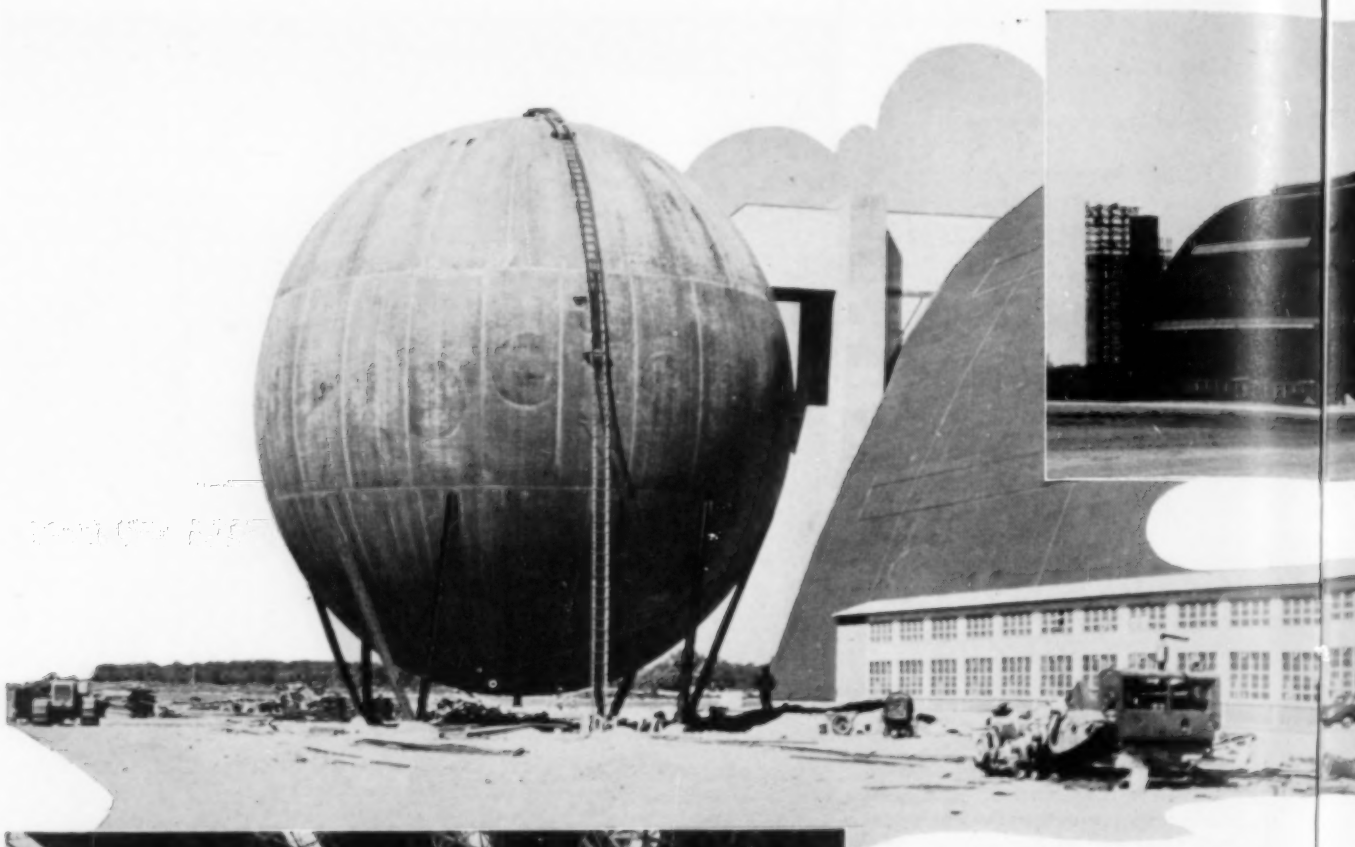
FIRE-RESISTANT lumber, airship hangars, and Navy blimps have, in combination, performed their several parts in driving enemy submarines from our coastal waters. The U-boat campaign against transatlantic shipping that inflicted staggering losses during 1941 and 1942 would probably have been still more ravaging in 1943 but for the means mustered by us to curb it effectually. One of our most telling weapons in waging war against the foe's underwater craft has been the nonrigid type of dirigible airship known as the blimp.

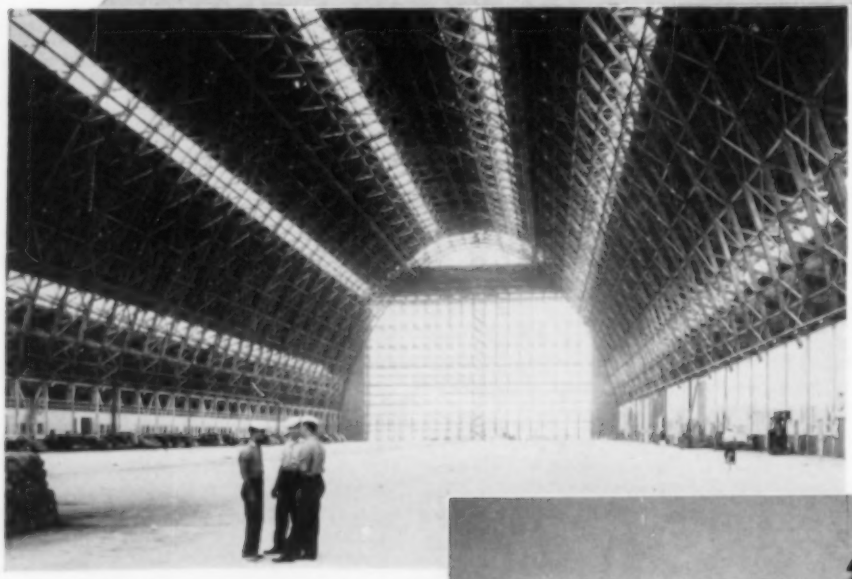
Ever since enough blimps were available for that far-flung service, they have made a fine record; and in order that they might operate to best advantage, strategically located bases were provided for them on our Atlantic, Gulf, and Pacific coasts. Suitable hangars had to be erected for them at these stations as quickly as possible and without any sacrifice in durability. In addition, the structures had to have physical characteristics in accordance with the controlling conditions at each location, and the construction materials had to be such as would not hamper other defense needs. The hangars were just one more pressing task that the Bureau of Yards and Docks of the Navy Department had to master and are evidence of the successful manner in which it deals with every situation that confronts it.

As some of us know, we used blimps to a modest extent for submarine patrol during World War I, but those dirigibles were not armed for offensive work. The hangars that housed them were temporary structures erected on our own shores and on the west coast of France, the largest of them being not more than 600 feet long and 80 feet high. During succeeding years the Navy had built for it four large, rigid airships: the *Los Angeles* and the *Shenandoah*, which were based at the Naval Air Station, Lakehurst, N. J., and the *Akron* and the *Macon*, each with a capacity of 3,000,000 cubic feet, which were based at Lakehurst and Sunnyvale Air Station, Calif., respectively. The first hangar at Lakehurst was of steel-frame construction and was 807 feet long, 316 feet wide at ground level, and 200 feet high. Those that were subsequently built at Sunnyvale and Lakehurst for the larger craft were 1124 feet long, 318 feet wide, and 194 feet high. Bear these figures in mind so as to be able to compare those structures with the housings recently reared to accommodate, in each case, a number of blimps that, because of their shape and color, are suggestive of a school of porpoises.

During the present war the earlier blimp hangars were of welded-steel arch construction, although considerably smaller than the housings built for our great rigid airships. But just about the time Germany was intensifying her submarine campaign, it became evident to our strategists that we would need many more blimps and a far larger number of hangars for their accommodation. With structural steel a critical material because of our greatly augmented shipbuilding program and other pressing wartime demands, the Bureau of Yards and Docks was confronted with the problem of how to design hangars that would be acceptable in every way and yet not use metal. The substitution of fire-resistant wood on a maximum scale and the employment of a minimum quantity of steel was the solution, arrived at after intensive study. The great timber structures that have resulted stand forth as a major engineering achievement. Capt. William H. Smith, Civil Engineer Corps, U.S.N.,—now director of the Planning and Design Department, Bureau of Yards and Docks—gives credit for this work to Admiral Carl Trexel, (CEC), U.S.N.; Capt. E. H. Praeger, (CEC), U.S.N.R.; Capt. G. A. Hunt, (CEC), U.S.N.R.; and to the bureau's principal engineer, Arsham Amirikian, and his assistant designing engineers.

The hangars are about 1058 feet long and 297 feet wide. They have a clear internal span of 234 feet, a height of 174 feet, and a span on the center line of the arches of 258 feet. Inasmuch as they had to be located in different sections of



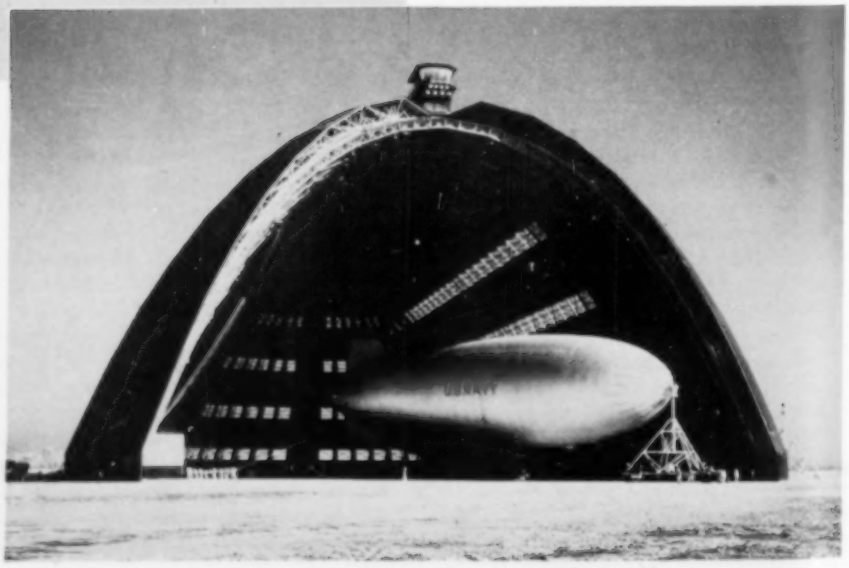


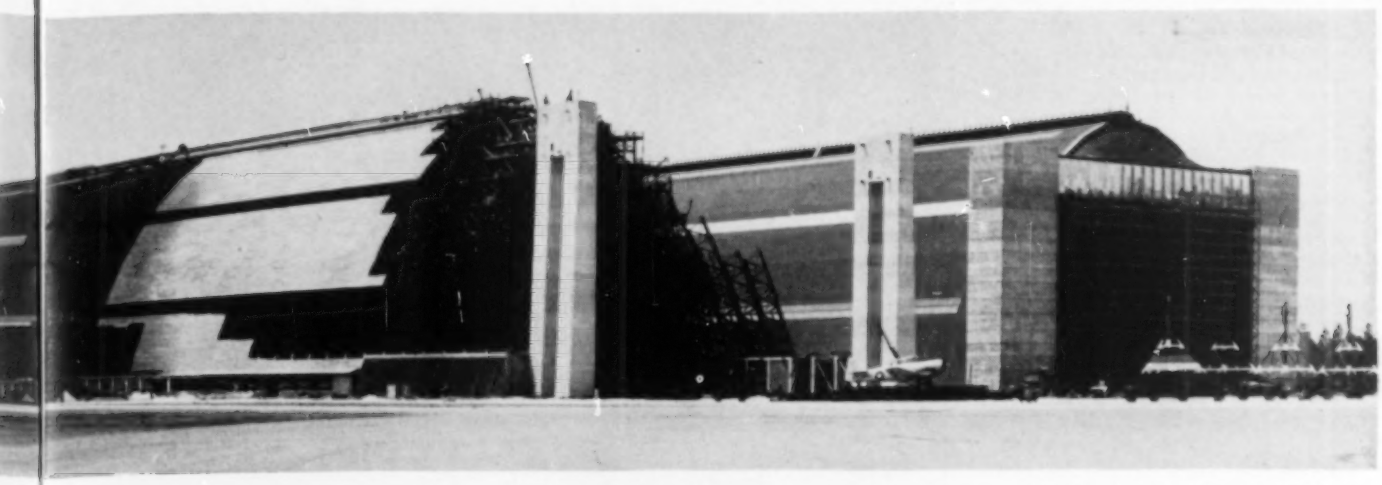
STRUCTURAL MONSTERS

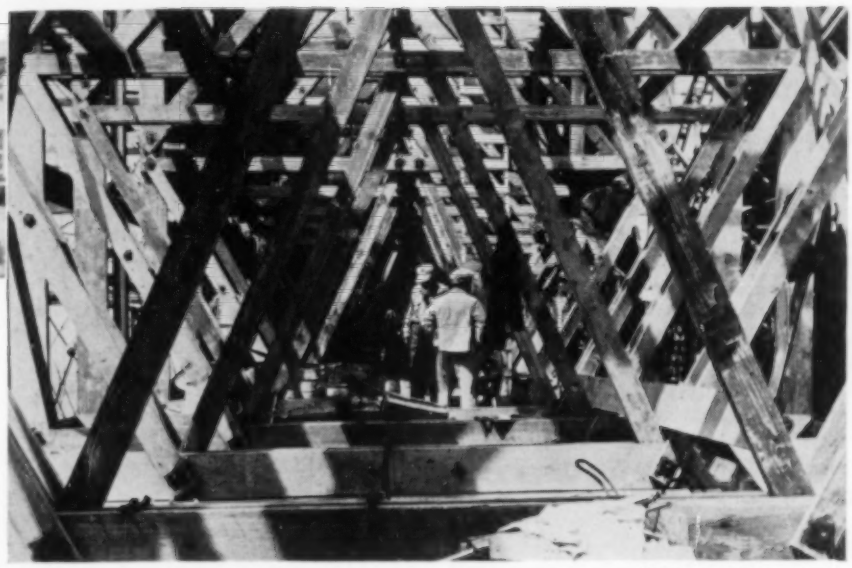
Each of the new hangars has enough floor space to accommodate three football fields, with space left over for spectators. The view at the right shows a blimp being brought out of a hangar by means of a mobile mooring mast that is pulled by a tractor.

the continent, each had to be built to meet the prevailing conditions or those likely to arise at its particular site. Accordingly, the hangars were constructed to withstand stresses that might be set up either by an earthquake, a hurricane, or a heavy snowfall. The amount of timber used for each varied from 3,100,000 to 3,500,000 board feet, the difference being due to the design characteristics and to the type of door provided to close the rectangular opening, 220 feet wide and 120 feet high, at each end of the cavernous structure.

The doors, by the way, are interesting features, and have to work surely and quickly. Usually, they consist of a series of sliding panels or leaves mounted on 2-wheeled carriage trucks that travel on parallel rails at ground level and on rollers that run on guides fastened to the overhead box girder that spans the hangar. The panels are 37.5 feet wide and 120 feet high, and their framing is







Official U. S. Navy Photos

CONSTRUCTION FEATURES

Above are shown two hangars, one finished except for its end doors and the other well along towards completion. Inside view of one of the timber box girders appears at the left. The picture at the extreme left shows a Hortonsphere in which is stored the helium gas with which our naval blimps are filled.

sheathed with fireproofed plywood manufactured in sheets 4 feet wide and 12 feet long. Generally, there are six overlapping panels; and when a door is open, three panels are housed out of the way at each side of the portal. All the plywood was treated with fire-retarding salts under pressure and in accordance with U. S. Navy specifications, which also applied to the sawed timbers and lumber used elsewhere in the construction of the hangars.

The arches which form the framework of the structures have a width of 19 feet at the base and 13.6 feet at the crown. The timbers in them range in dimensions from 3x8 and 4x8 inches at the crown to 4x14 and 6x14 inches where they rest on their reinforced-concrete supports. They were assembled on the ground and fastened together with ¾-inch bolts and 4-inch Teco connectors. The arches are spaced on 20-foot centers, and the flying buttresses from which they rise are in the form of rigid frames that reach to a point approximately 25 feet above ground level.

The substitution of timber for steel, apart from presenting many structural difficulties, introduced another problem—that of providing protection against fire. This was a matter of the utmost moment. It is true that our blimps do not in themselves present a fire risk, because we are fortunate in being able to fill them with noncombustible helium from domestic sources. Even so, there is a fire menace in the lean-tos that hug the base on each side of a hangar at ground level and that house the operating offices, workshops, and serve as storage spaces for equipment and supplies. Although adequately safeguarded with a sprinkler system, these provisions do not suffice because there always remains the unpredictable and uncontrollable fire hazard—lightning, which is one of the principal sources of fire losses in some sections of the United States.

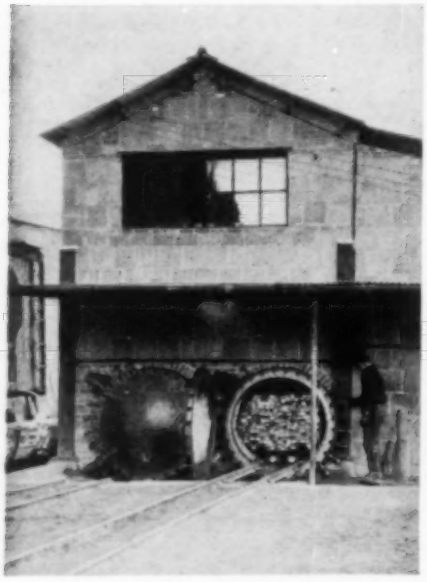
Before the experts found a satisfactory answer to this vital question, says Captain Smith, consideration was given in the early stages of the design to deluge sprinklers, hose reels on the roof, and similar equipment. The difficulties of providing reliable protection by these measures; the danger to men atop the arch roof, nearly 200 feet in the air, fighting flames underneath them; the problem of supplying sufficient water to combat a serious fire in a structure of this size; and the consumption of critical materials for any adequate system, all dictated a different approach to the question of fire protection.

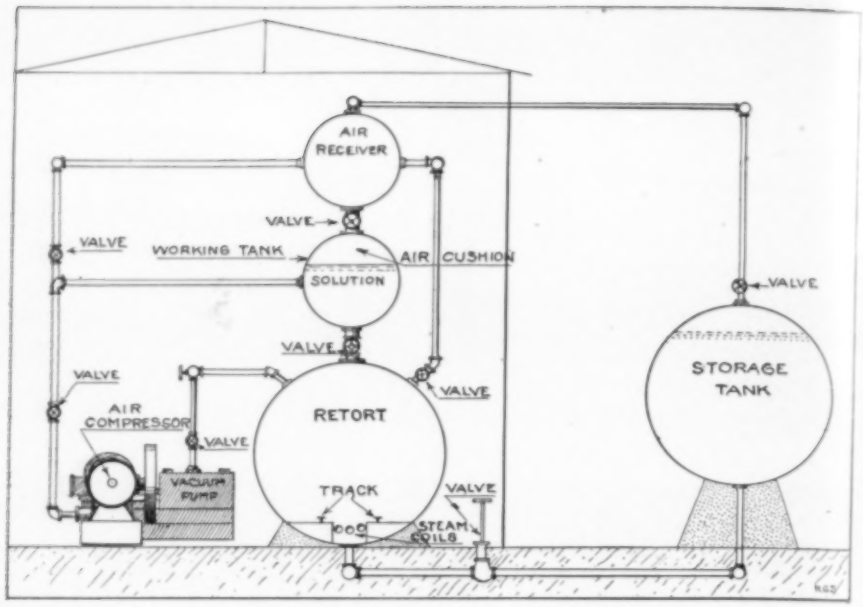
The Navy, as far back as 1895, had built several gunboats especially for operation in the rivers of China, and as the decks of those vessels were likely to be exposed to gunfire and conflagration, they were planked with timber that had been given a fire-retardant treatment. Subsequently, the Bureau of Yards and Docks found various applications for such lumber. Today, timber is also treated with preservatives to make it resistant to decay and insect attack. The generally accepted practice of impregnation calls for the pressure treatment, or what is known to the trade as the full-cell process. The work usually calls for different treatments, which may be grouped as follows: two for fireproofing, one combination type for fireproofing and wood preserving, and two for straight wood preserving. In any event, the solutions used are combinations of eight chemicals which are variously mixed in accordance with the particular treatment desired. In the case of the hangars, much of the wood was impregnated with solutions containing fireproofing chemicals as well as salts to protect it from decay.

In 1930, the U. S. Bureau of Commerce issued a bulletin which had to do with treated lumber and its general uses and economies and which contained the following significant statement: "The superiority of pressure-treated lumber as compared with non-treated lumber has been established definitely by expe-

TIMBER-TREATING PLANT

The wood used in the hangars to save critical steel is impregnated with chemicals to make it fire-resistant. The view below shows a train of timber ready to be withdrawn from a retort at the plant of the Protexol Corporation at Kenilworth, N.J. The diagram illustrates the arrangement of the essential equipment of the process. After the door of the retort has been closed on a trainload of timber, the air is evacuated, after which the overhead valve is opened and impregnating fluid introduced. Air pressure is then applied to force the liquid into the cellular structure of the wood. Steam coils at the bottom of the retort heat the solution to facilitate its penetration. At the end of the treatment period, surplus chemical is forced out of the retort by air pressure and into the storage tank at the right.





rience covering a long period of years." About two years ago the U. S. Forest Service, in collaboration with the American Wood-Preservers' Association, reported that "The total quantity of wood given fireproof treatment in 1942 was 22,284,000 board feet. In the treatment of this immense amount of material, 5,151,000 pounds of chemicals were used." Of that total, 2,700,000 pounds, or 52.5 percent, was what is known as Protexol, the principal compounds of which are ammonium salts. This fact is mentioned because the U.S. Navy blimp hangars were constructed of lumber treated, to a large extent, by the Protexol Corporation either at Kenilworth, N. J., or in its eleven affiliate plants located throughout the country.

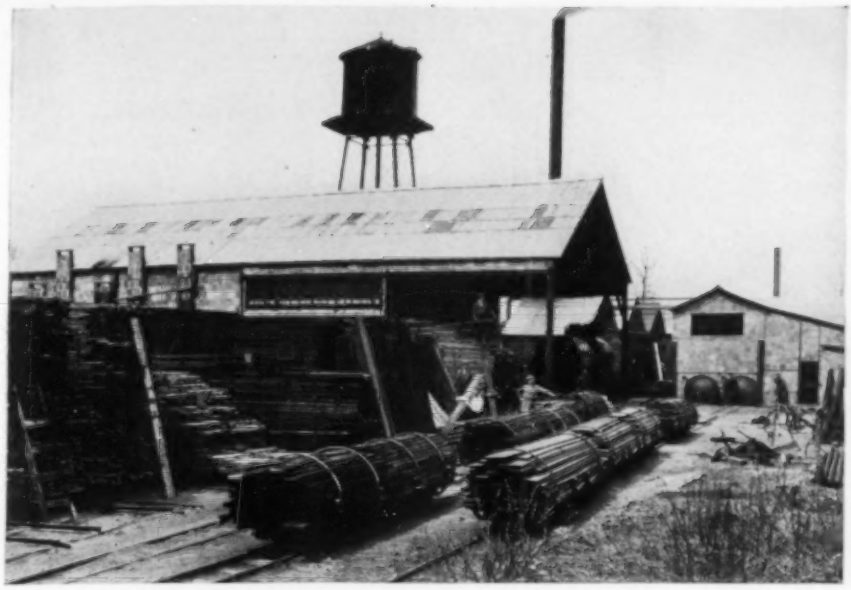
The process employed at Kenilworth utilizes both vacuum and air pressure at different stages to obtain the specified results. Housed in the power plant is a Type FR-1 steam-driven compressor that has been working continually for a good number of years. This machine provides air at a pressure up to 95 pounds, but it is also used in reverse to induce a vacuum of 27 inches, plus. For higher pressures, a newer 3-stage compressor is available. Although some pumps are installed to handle the solutions, their transfer is mostly achieved through the medium of compressed air and vacuum, alternately brought into service as circumstances dictate. Mixing is done in a large open-top tank, and in this work the necessary agitation is effected by compressed air discharged from a submerged outlet. From the stirring tank, the solutions are delivered to storage tanks.

The lumber to be treated may range from 1 inch to 12 inches in thickness and is loaded on trams—low rectangular steel frames mounted on small car wheels that travel on narrow-gauge track. At each side of a tram are short, curved, upright brackets that limit the lateral spread of the load, which is assembled within a ring template. Straps passed over the lumber and secured to the brackets hold each load in place when a tram or train of trams is run into one of the two cylindrical retorts with which the plant is equipped. As the sticks are being loaded lengthwise, separators are interposed between the several layers to keep them far enough apart so that the chemicals in which the lumber is to be submerged will have free access to all external surfaces.

Should the wood received at the plant be "green"—newly cut, the material must be rid of any excess moisture to make it fit for impregnation. This is removed by first subjecting it for from two to eight hours to low-pressure steam at temperatures ranging from 220 to 260°F. After that it is placed under a vacuum to stimulate evaporation at subatmospheric pressure such as is resorted to in the case of some improved methods of dehydration to permit drying foodstuffs at lower than boiling-point temperature.

The treating retorts at Kenilworth are steel cylinders each 50 feet long and having an internal diameter of 4 feet. The shells are of welded construction while the heads are riveted, providing units that are more than capable of withstanding the stresses set up by the highest pressure needed for the heaviest lumber processed. On the bottom of each retort is a track of the same narrow gauge as that over which the trams are moved. Between the tracks are longitudinal coils in which steam can be circulated to heat the solution to the temperature required for any given lot of lumber. Some woods have to be impregnated at lower temperatures than others to avoid distortion.

An accompanying diagram shows the interrelated features of the plant and will make it easier to follow the various steps of the process. Let us assume that a loaded tram has been shoved into one of the cylinders and that the massive door has been swung tight against a seating by numerous hinge bolts inserted in radial slots around the rim of the door. At that stage the vacuum pump starts to withdraw the free air from within the retort and, incidentally, to evacuate the cellular spaces in the wood. When the gauge in the power plant shows that a 22-inch vacuum has been pulled on the retort, then that vacuum is held for approximately one hour. During that time, any air in the lumber is extracted, thus assuring substantial initial absorption of the impregnating fluid with which the cylinder is filled as soon as the vacuum pump is cut off. When the valve in the solution line is opened, the vacuum in the cylinder draws the chemical into it from one of the storage tanks, which are placed at a higher elevation out in the yard. However, air pressure can be ap-



LUMBER READY FOR TREATING

Trains of boards awaiting their turn to be run into the retorts, whose ends are visible in the building at the right.

plied to the liquid in any storage tank if it be necessary to feed it more quickly.

Above and parallel with each retort is a shorter and smaller working tank that is partly filled with the impregnating fluid. The latter tank, in turn, is surmounted by an air receiver connected with the compressor plant. Between the working tank and the retort is a solution line with an interposed valve. When that valve is opened, air from the receiver flows into the working tank and exerts pressure against the free surface of the liquid. That pressure is instantly transmitted to the solution in the retort, thus forcing it into the lumber and effecting either partial or complete penetration, as may be specified. In the case of the wood fireproofed for the Navy hangars, material up to 2 inches in thickness was given complete penetration, while the heavier members of the arches had a treated zone of ample depth to insure protection.

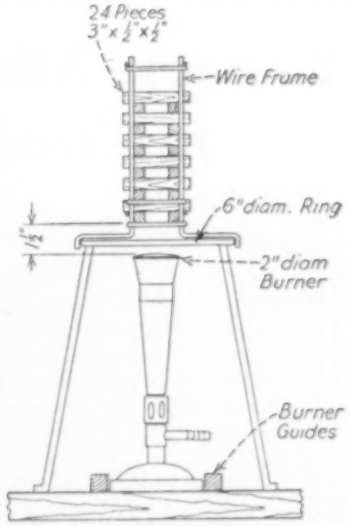
The pressure exerted on the solution to force it into the lumber varies considerably in general practice, depending upon the species of wood, its thickness, and its physical characteristics. It also differs with the depth of penetration, which is controlled by both pressure and length of time it is applied. The pressures used may run from zero gauge (atmosphere) up to 200 pounds per square inch, and may be exerted for a few hours or for fully 24 hours, while the temperature of the solution may range from atmospheric at the time of application to 190°F. In other words, the treating process is a flexible one capable of meeting any demand placed upon it by woods of differing kinds and sectional masses and by the degree of penetration specified in each case.

After the lumber has been under pressure long enough to satisfy requirements, the valve between the working tank and the retort is closed, and the solution in the chamber is discharged by applying pressure from the air receiver to force it through the feed line back into its storage tank. Then the valve in the solution line is closed and vacuum as again drawn on the retort for a short while to take care of drip and the unabsorbed liquid still clinging to the surface of the timber. With that done, the vacuum is released and the entrance door of the cylinder is unbolted and swung aside for the withdrawal of the treating trams. The lumber is next stacked on larger trams in layers, with interposed separators, and placed in a kiln.

The drying kilns have concrete floors traversed laterally by ducts connecting with longitudinal trenches, one along each side of the floor, in which are steam-heating coils as well as steam sprayers. Through the center of the kiln runs a connecting trench in which are reversible power-driven fans. In this way the heat is distributed in trausverse, circling currents that envelop and pass through the spaces between all the layers; and as these currents can be reversed, the wood can be dried under nice control and to the extent specified.

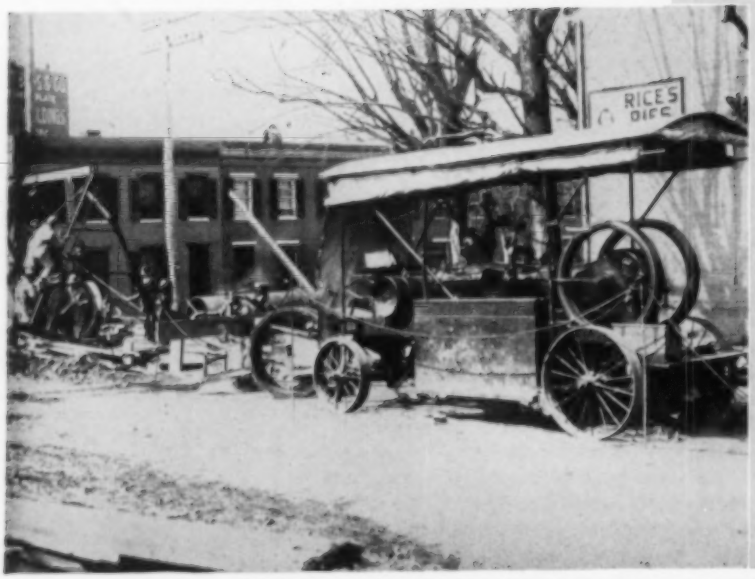
But the correctness of the impregnating solutions used and the precision with which the process is applied are not, in themselves, sufficient. Out of each lot of 5000 board feet of treated timber a sample must undergo what is familiarly known as the crib test prescribed by the American Society for Testing Materials. The arrangement of the test assembly is indicated in an accompanying drawing. As will be seen, 24 pieces, 3 inches long by ½ inch square in cross section, are stacked in a wire frame beneath which is placed a Meeker type burner the top of which is only 1½ inches below the bottommost layer. When lighted, the gas burner must carry a blue flame having a height of 10 inches, plus or minus ½ inch. Its temperature at first contact with the grid of pieces is about 1300°F., and the wood must be exposed to the action of the flame for three minutes. While the wood may char more or less where exposed to the hottest part of the flame, and may even be glowing if not blazing before the burner is shifted, flaming usually ceases immediately thereafter, while the residual glow, in a satisfactory test, dies out in a few seconds.

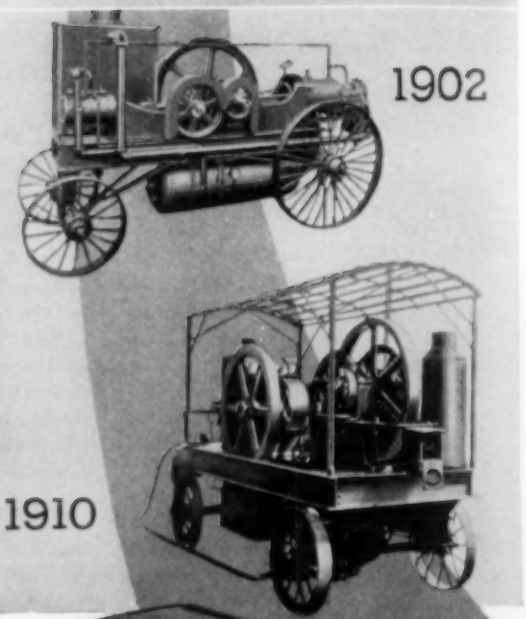
The object of the protective process is not fireproofing but to obtain a pronounced degree of fire retarding. The virtue of the treatment, then, is to make an ordinarily highly combustible material slow to yield to flames and by so doing hamper the spread of a blaze and thus give fire-fighting equipment time either to arrive or to get into action in dealing with the situation. All lumber treated by the Protexol process for the Navy's blimp hangars had to pass the foregoing test to prove that it could meet the exacting specifications drawn up by the experts of the Bureau of Yards and Docks, of which Vice Admiral Ben Moreell, Chief of Civil Engineers, U. S. Navy, is the head.

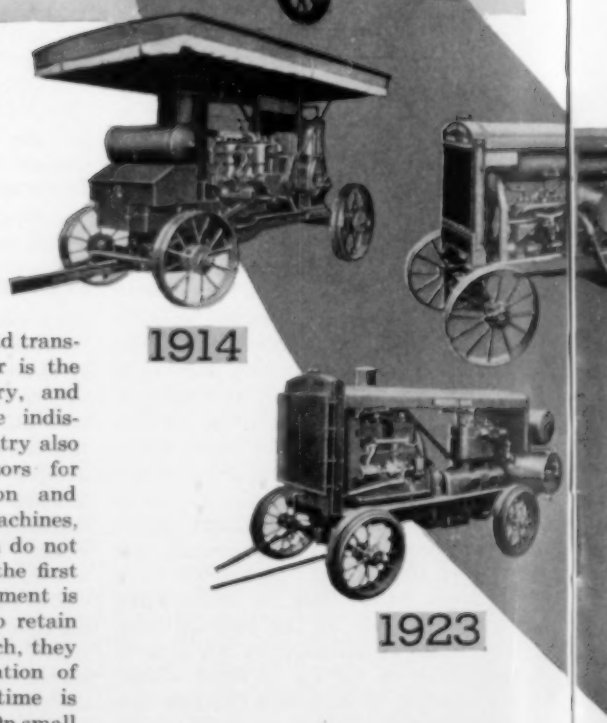


TEST SET-UP

Assembly of crib and burner prescribed by the American Society for Testing Materials to expose treated wood to a 1300°F. flame for three minutes. To pass the test, the wood must cease to burn as soon as the flame is removed, and residual glow must die out within a few seconds.







Portable Air Compressors in Utilities Work*

C. T. Chapman

COMPRESSED air is now such a commonly used form of power that many people take it for granted, do not give it the thought and attention it deserves. It has been one of the great forces in the development of our industrial life, and has grown to be a vital necessity in our world. No subways, railroads, tunnels, skyscrapers, aqueducts, mines, quarries, or general construction jobs, ships, or airplanes would be as they are today without compressed air, and so far no substitute has been discovered for it for many purposes. Its uses in general industry are legion.

The handling, compression, and transmission of gases other than air is the foundation of the gas industry, and stationary air compressors are indispensable equipment. The industry also uses many portable compressors for operating tools in construction and maintenance work. These machines, for several logical reasons, often do not get the care they require. In the first place, mobile compressor equipment is generally built in small units to retain the feature of portability. As such, they readily slip away from the attention of the trained engineer, whose time is occupied with bigger problems. On small construction jobs and scattered main-

*Essential substance of a paper read before the Technical Section of the American Gas Association.

tenance work, portables may operate far from headquarters, with care and supervision frequently provided only by the men who run them. Their life is fairly long (ten to fifteen years is not unusual) and so long as a unit appears to be operating well, it is left alone. Some companies make intelligent efforts to maintain their portable compressors at top efficiency; but, in general, there is room for considerable improvement.

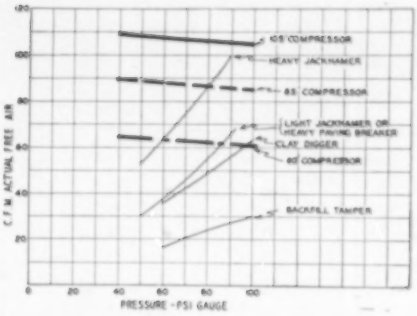
In this paper I will present facts, at my disposal through experience, to support the claim that better selection, maintenance, and use of portable air equipment bring large cash returns, far greater than is generally realized. Up to about 1912, air tools were limited in variety and use, and were extremely heavy for the work they performed. A good "light" rock drill weighed around 200 pounds and was mounted on a heavy tripod, bringing the total weight to around 500 pounds. It required an experienced operator, a second man as helper, and consumed so much air that a large stationary compressor was needed to supply it. You didn't trifle with a drill of that type; you attempted to avoid its use.

About 1912, Ingersoll-Rand Company brought out the Jackhamer—a light, 1-man rock drill weighing about 45 pounds, and thus made real portability of air equipment practicable. This tool drilled rock rapidly and used so little air that a compressor large enough to run it could be mounted on wheels and taken out on a construction job. Of course, the first portables left much to be desired. They were huge, unwieldy affairs weighing tons and did not deliver much air. But from them, and much research and development, has come the modern portable compressor with which all of us are acquainted.

The uses of and demands for portable air equipment have grown so tremendously during this war that lightweight, portable, gasoline-engine-driven units are to be found on most advanced battlefronts. Even with their drivers, some machines for up to 2000 pounds pressure and of surprisingly large capacities weigh so little that they can be packed around readily by two men. Thus, there are available today extremes in light weight and portability so that a commercial user of portable air equipment is faced with the fundamental engineering problems of proper selection, durability, and economy.

The primary purpose of the first portable air compressors and tools was that of drilling rock, and rock drills are still the largest consumers of air produced by portables. Paving breakers, clay spades, and other tools use less air, so the sizes of portable compressors were designed to meet the needs of rock drills. The 110-cfm. single-stage, water-cooled unit of the era prior to about 1933 could operate one rock drill of its day at about 80 pounds pressure. Hundreds of those machines were sold. They ran for years, became almost standard throughout the country, and established a rough compressor-size yardstick that exists today in spite of improvements in design and efficiency.

The wide possibilities opened by portable equipment of this kind sponsored engineering advances that meant money in owners' pockets. Tools were built to do more work and to use less air, and compressors changed rapidly.



HOW MUCH AIR

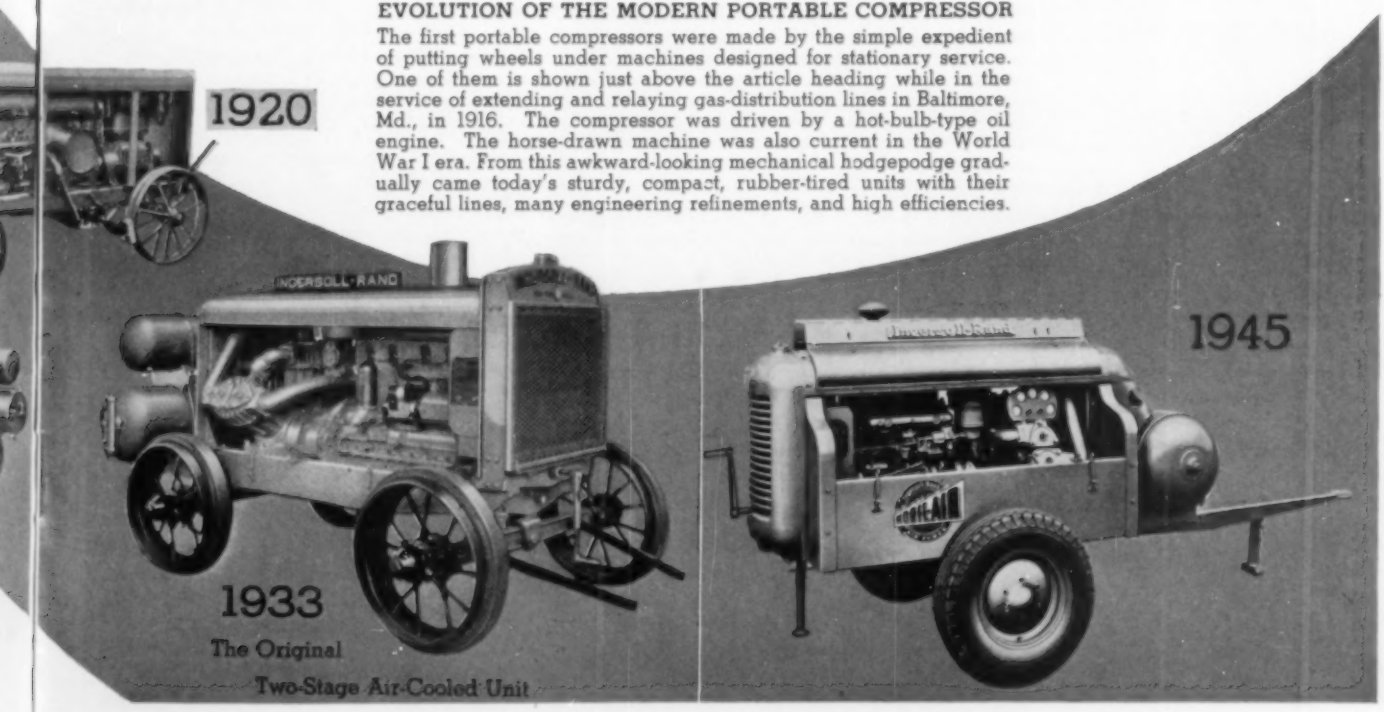
Curves show the air requirements of various tools and the output of modern portable compressors of three different sizes.

Since a portable has no really cool water for cooling air and cylinder jackets, air-cooled compressors were constructed. Two-stage compression is considerably more efficient than single-stage, so 2-stage machines with air-cooled intercoolers were made and engines were improved. Variable-capacity regulation was provided to vary the air output in accordance with job requirements.

With pride in the highly efficient portables they have produced, compressor manufacturers now tell customers how much air their machines will actually deliver. The old single-stage, water-cooled, 110-cfm. unit was rated on theoretical piston displacement only. If it delivered as much as 75 cfm. of actual free air at 100 pounds pressure it was exceptional. A volumetric efficiency of 68 percent is still high for a single-stage, commercial machine of this size and type. The new 2-stage, air-cooled compressors run well over 80 percent in

EVOLUTION OF THE MODERN PORTABLE COMPRESSOR

The first portable compressors were made by the simple expedient of putting wheels under machines designed for stationary service. One of them is shown just above the article heading while in the service of extending and relaying gas-distribution lines in Baltimore, Md., in 1916. The compressor was driven by a hot-bulb-type oil engine. The horse-drawn machine was also current in the World War I era. From this awkward-looking mechanical hodgepodge gradually came today's sturdy, compact, rubber-tired units with their graceful lines, many engineering refinements, and high efficiencies.



TAMPING BACKFILL

A modern portable compressor in utility service. As the earth is put back in a trench that was excavated with the aid of air-driven paving breakers and rock drills it is consolidated with pneumatic tampers.

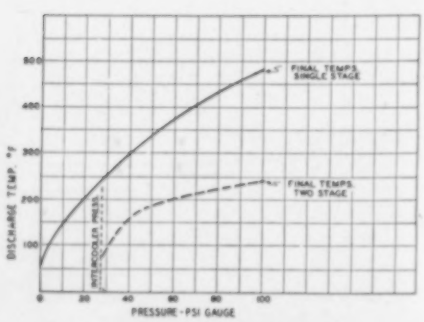
volumetric efficiency and are rated and sold on the basis of air actually delivered. Thus the modern 105-cfm. portable has 40 percent more capacity than the old one rated at 110 cfm. It deserves closer attention in its service application than just the conventional thought that a portable of about 100 cfm. will do the job. With the new, more efficient air tools, both the 85- and 60-cfm. compressors are finding a wide market, and when properly applied are entirely successful from the operating standpoint, lower in first cost, lighter to handle, smaller in size, and less expensive to run. Also, with improved over-all economies and lighter weight, portable units up to 500-cfm. capacity are common for the larger construction jobs.

Air-compressor companies have been building portables throughout the war in huge quantities—building them to operate where compressors never operated before—building them lighter, tougher, and sturdier—making them run cooler to stand terrific tropical heat—to run with less skilled attention and maintenance—to run more economically, saving gasoline and oil. As these refinements have been made, they have been incorporated, one by one, into the portables offered at home. You do not need to wait for "postwar portable compressors and tools." They are growing daily before your eyes, with changes so gradual that they are hardly noticed. But the sum total of the improvements is so great that you cannot afford to retain much of your old compressed-air equipment. Obsolescence will claim its own.

In choosing new equipment, start with a study of the work to be done. If one Jackhamer running at 80 pounds pressure will do all that is needed, and requires only 70 cfm. of air to operate it, an 85-cfm. compressor will do just as well as a 105-cfm. unit. The smaller compressor costs less, is lighter, and runs more economically. For maintenance and service work, many utilities are using 60- and 85-cfm. compressors rather than the conventional 105-cfm. machines. If the work justifies a large number of tools, one or two large compressors will perhaps be better than several small units for the same reasons. Air is economical, convenient power. There is a multitude of uses for it, and labor-saving tools are worth considerable study.

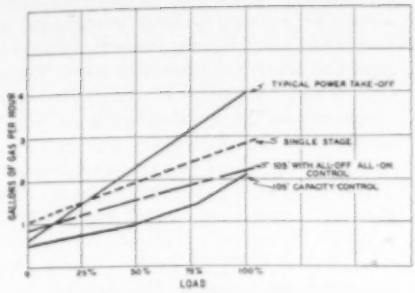
Having selected the desired size, give thought to fundamental facts on compression of air when you choose the type. The theoretical discharge temperature of 60°F. air when compressed to 100 pounds in a single-stage compressor is 485°F. There is no cool water on a portable compressor for reducing this temperature appreciably, and air-cooling a single-stage 100-pound unit is quite a trick. An excellent lubricating oil will flash at 375° to 400°F., so cylinder and valve lubrication is obviously a problem on a single-stage unit, and rubber does not improve under high temperature.

The corresponding theoretical discharge temperature of a 2-stage air compressor operating at 100 pounds is much lower, so that the problems of bearings, lubrication, maintenance, and cooling are much simpler. Two-stage air-cooling gives safe and efficient discharge temperatures. In addition, the volumetric efficiency of proper 2-stage compression



HEAT OF COMPRESSION

Comparison of theoretical discharge temperatures of air compressed to 100 pounds pressure in one and two stages.



GASOLINE CONSUMPTION

Fuel requirements of various types of portables used in utility maintenance work.

is 15-20 percent better than 1-stage compression to 100 pounds pressure. For these reasons, most compressor builders offer only 2-stage machines.

Both gasoline and fuel-oil engines are standard and available for units down to 105-cfm. size. These are all reliable, moderate-speed, heavy-duty machines, with good torque characteristics, long life, and reasonable maintenance. The oil-engine-driven unit will operate at a lower fuel cost, but in small sizes its first cost is about 20 percent higher than that of the gasoline unit and 10 percent higher in larger sizes. The difference in fuel cost may wipe out the investment differential in a relatively short time, but a few other points should be considered. The weight of the diesel-type oil engine is more than that of the same-size gasoline-driven machine. On very light loads most oil engines have a tendency to cool off, and since the ignition of a diesel engine is a function of its temperature, light loads tend towards irregular engine operation. Thus the diesel-driven unit is generally best suited for heavy-duty jobs.

The spark-ignition oil engine, with assured firing at all loads and speeds, avoids these light-load operating problems, but its full-load operating economy is slightly less than that of the full diesel unit. This spark-ignition-type oil engine also has the advantage of operating either as a gasoline engine or as a fuel-oil engine by substituting a fuel-oil pump for the gasoline carburetor; and the oil-engine unit weighs only about 100 pounds more than do gasoline units.

One major intangible point for consideration in the choice between gas-engine and oil-engine drive is the fact that the present generation in the United States has grown up with the gasoline engine; and, like a "darky" with a mule, can get good results with it. The oil engine, which should have intelligent, systematic care to give best results, frequently suffers from "tinkeritis." Practically all internal-combustion engines in fair-sized portables today are water-cooled because no large air-cooled engines with suitable torque, speed, and power characteristics are available.

You will probably select a compressor large enough to run the biggest tool or tools you will normally use. Thus, for a large share of the time it may operate smaller tools requiring less than its full capacity. Until recently, the only way of regulating a portable was to run it either at full capacity at full speed or completely unloaded at a low idling speed. If 75 percent of the full capacity was needed, the unit would run alternately at full load 75 percent of the time and at no load 25 percent of the time. At no load and idling speed, the gas consumption is from 25 to 35 percent of the full-load gasoline requirements, and this fuel is just wasted because it produces no useful results.

The newest type of compressor-capacity regulator automatically runs the unit at full, ¾, or ½ speed to provide the capacity needed to meet the air demand. Gasoline consumption is better at the reduced loads. The machine drops to no load and idling speed only when less than half capacity or no air at all is demanded. These newer units, with recent improvements in design, deliver 100 cubic feet of air at full load for only 85 percent of the gasoline that was required about three years ago. With this initial economy, plus large gasoline savings at part-load operation resulting from the new control, the gasoline savings run into figures well worth studying.

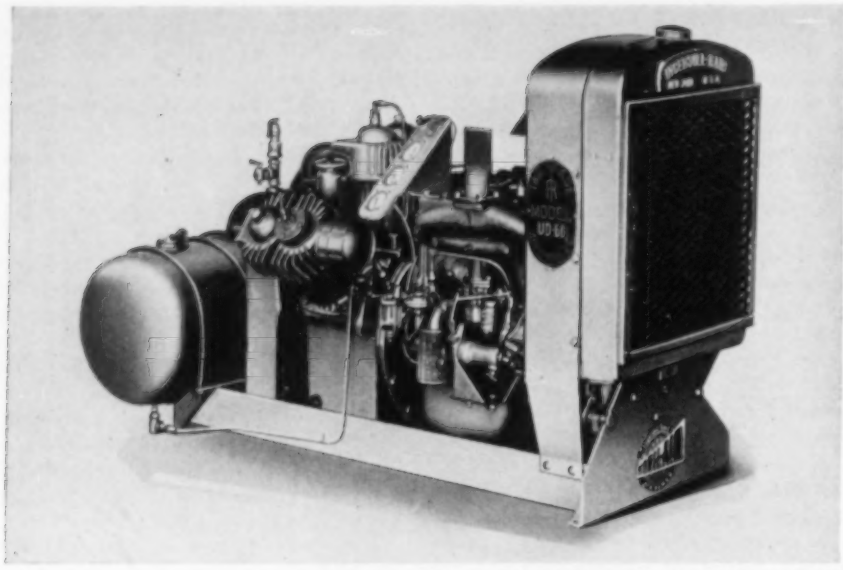
One type of compressor that has met with some success in the past few years in utility truck service is the power take-off unit V-belt driven from the truck drive shaft. The advantages that have been claimed for it are light weight, low first cost, and small size; but close engineering scrutiny will present certain disadvantages. The 105-cfm. power take-off unit installed on a customer's truck costs about $1400, compared with $1700 for a complete 105-cfm. standard unit on skids, so the price differential is not tremendous. The work done by these 105-cfm. truck-mounted utility compressors could frequently be done with an 85-cfm. unit weighing and costing less than the larger-size machine, so the primary selection of the power take-off compressor may be subject to question.

The operating story of the power take-off machine, as compared with a standard portable unit, is surprising, and accurate figures may be of interest. The gasoline engine driving a standard portable is a heavy-duty, slow-speed, efficient unit with excellent torque characteristics. It has plenty of excess power over compressor requirements, is direct-connected to the compressor, and is built for years of service. At full load its maximum speed is 1200 rpm. It is usually equipped with removable cylinder liners, large bearings, a full-size radiator for adequate cooling, and a manifold heater for winter service.

The light truck on which the power

ON A NATURAL-GAS LINE

Easily moved trailer-mounted portable compressors facilitate the laying of our vast network of underground pipe lines for conveying oil, gas, and water. Here one of them is furnishing air power to revolving wire brushes used for cleaning pipe sections prior to coating them with a protective material.



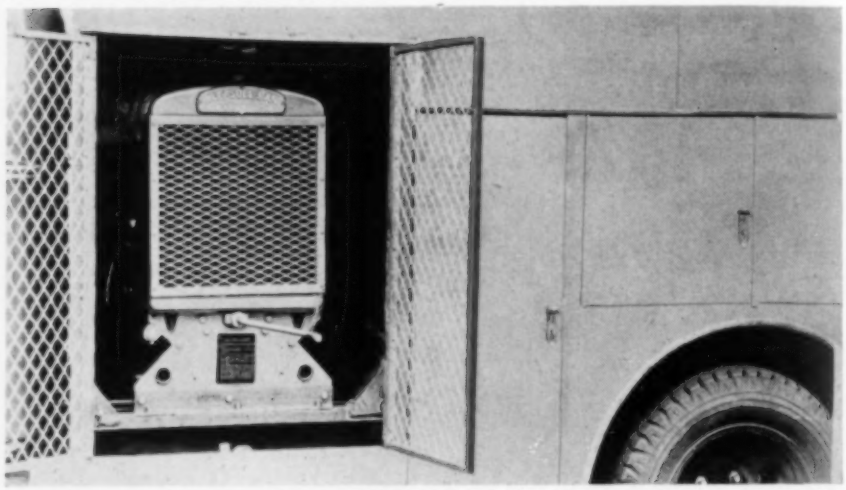
take-off unit is mounted has no such power plant. Its engine runs about 1800 rpm. at full load. It is designed to operate at ¼ to ½ its average rated power when driving the truck; its radiator is figured on this low-load basis; and, in addition, the forward movement of the truck is counted upon to furnish part of the radiator cooling effect. The engine is designed for best economy at about one-half its rated power; at full load and high mean effective pressure its economy is poor: and at no load its gasoline consumption is also high. By actual shop test, one of these 105-cfm. power take-off units mounted on a popular, lightweight truck uses 4 gallons of gasoline per hour at full load, compared with 2.08 gallons per hour for a standard portable of the same size. Within a year or two the gasoline savings alone would pay the difference in first cost in this particular case.

This fuel expense is only the beginning, however. A light-truck engine must be replaced once or twice during the life of the truck, because under the long hours of compressor service at heavy load and high mean effective pressure, radiators are troublesome and other items of expense creep in.

Several large public-utility companies recently made a careful study of this general compressor problem from their own experience. It was based on prices prevailing immediately prior to the war, as it is obvious that present war prices would present a greatly distorted picture. The figures are shown in the accompanying tables. The conclusion reached was that, even under the most favorable conditions, the power take-off unit is not right, economically; and with the trend towards higher truck and gasoline prices the showing becomes worse.

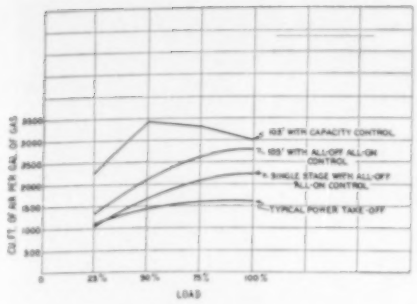
One thought frequently advanced in favor of the power take-off unit is that, because of its light weight and small space occupied, it can easily be mounted on the same truck that carries tools and men. This claim is fully recognized in the tabulation figures, which include a separate truck for tools and men. However, a more careful study of service-and-maintenance truck work will show that a compressor smaller than the 105-cfm. will usually meet every requirement. These smaller units weigh 1250 to 1700 pounds, compared with about 1350 pounds, the complete weight of the 105-cfm. power take-off unit. If mounted crosswise on a truck, the smaller, self-contained machine takes up little more space than the 105-cfm. power take-off unit.

A recent close check on a 60-cfm. compressor on a gas-company maintenance-and-service truck shows that it is satisfactorily handling every air demand. It operates a light Jackhamer at 90 pounds pressure, a large paving breaker



MODERN MOUNTINGS

The work of utilities in cities usually calls for relatively small compressors, and they are frequently mounted on trucks that also carry hose lines and tools. The center picture shows that only a small part of the truck body is required to house the machine. A 60-cfm. gasoline-engine-driven compressor designed for truck mounting appears at the top. Trailer-mounted units (bottom) also are much used in this service. The machine pictured delivers 105 cfm. of air at full engine speed, is equipped with a regulator to cut the fuel consumption in proportion to the load, and is driven by a gasoline engine that can readily be converted to use fuel oil.


CU. FT. OF AIR PER GAL. OF GAS
LOAD
105' WITH CAPACITY CONTROL
105' WITH ALL-OFF ALL-ON CONTROL
SINGLE STAGE WITH ALL-OFF ALL-ON CONTROL
TYPICAL POWER TAKE-OFF

AIR-FUEL RATIO

Comparison of volumes of air delivered per gallon of gasoline by different types of portable compressors.

at 85 pounds, a clay spade or a backfill tamper at 100 pounds—indicating that, in some cases at least, a larger unit is not justified.

For some years past, tool designers have been giving attention to the attitude of the operator toward the air tool he runs, and great advance has been made in improving the holding qualities. New tools are now built with full-cushioned piston action, so that jarring and shaking of the operator is minimized. The tools are easily held and don't break parts, provided workers refrain from riding them constantly. In a day's work, increased drilling is gained by relieving the strain on the men, and this greater ease of handling is appreciated by the operators.

About four years ago the Government went deeply into the engineering study of portable compressors in purchasing these machines in great numbers, and the Bureau of Standards specifications call for a minimum of 420 cubic feet of actual delivered air at 100 pounds gauge discharge pressure per pound of fuel consumed. At that time some compressors had difficulty in meeting the specified performance, but the present-day air deliveries of a 105-cfm. unit, equipped with the new type of control, are 490 cubic feet per pound of fuel at full load; 530 cubic feet at three-quarter load; and 550 cubic feet at one-half load.

COMPARISON OF COSTS

The figures that follow summarize the results of the survey previously referred to as having been made by several utility companies to determine relative over-all costs of a standard truck-mounted compressor, a power take-off unit, and a 2-wheel trailer unit of the same size.

This survey is based on using a truck ten years when a complete engine-driven compressor unit is mounted on the truck. With power take-off, a new truck is bought at the end of five years and a new engine is installed in the chassis every 2½ years. When a truck-mounted unit is used, an extra truck is required to haul men and materials. This would apply when operating on leak service, but not on other services. It is also based on a 12 percent charge to cover all overhead, insurance, taxes, etc.

TABLE ONE

Comparison Between Three Types Size 105-cfm. Portable Compressors

Power Take-Off		Self-Contained Gasoline-Engine-Driven Truck-Mounted Unit	
Approximate cost of body	$850.00	Approximate truck cost	$900.00
Compressor cost	793.00	Mounting compressor on truck	100.00
Approximate truck cost	900.00	Cost of complete compressor unit	1700.00
V-belts	35.00	Cost of additional truck to haul men	1750.00
Power take-off	200.00		$4450.00
Pulley	25.00	Two-Wheel Trailer Unit	
Controls	35.00	Approximate truck cost	$900.00
Air receiver	55.00	Approximate body cost	850.00
	$2893.00	Two-wheel trailer-type compressor	2000.00
			$3750.00

TABLE TWO

First Cost Power Take-Off Based On 10-Year Life

1	Total cost from Table One	$2893.00
2	New truck end of five years	900.00
3	Two engines for truck in 10 years because engine also operates compressor	150.00
4	Transferring body and installing power take-off in new truck after 5 years	110.00
		$4053.00
	Self-Contained Truck-Mounted Unit	
5	First cost from Table One	$4450.00
	Two-Wheel Trailer Unit	
6	First cost from Table One	$3750.00

TABLE THREE*

Engine Compressor Unit Two-Wheel Trailer Unit — Gas Consumption From Government Test		
Full load and speed	2.13	gals/hour
¾ load and speed	1.49	"
½ load and speed	0.96	"
Power Take-Off		
Full load and speed	2.56	"
¾ load	2.13	"
½ load	1.71	"

	Power Take-Off			Gas-Compressor Unit Two-Wheel Trailer		
Load Factor	100	75	50	100	75	50
Gals. per year	4200	3620	2820	3620	2460	1580
Cost of gas per year	$504	$434	$338	$435	$295	$190
Cost for 10 years	$5040	$4340	$3380	$4350	$2950	$1900
Savings for 10 years	....	....	....	$690	$1390	$1480

*Operating cost based on 10 years and 5½-hour working day, 300 days a year, gasoline at 12 cents a gallon. Total hours per year, 1650.

TABLE FOUR—SUMMARY

Power Take-Off

Depreciation, Item 1 Table Two, in 10 years except truck	$199.30
" " 1 Table Two, truck in 5 years	180.00
" " 2 Table Two, truck in 5 years	180.00
" " 3 Table Two, two engines in 5 years	30.00
" " 4 Table Two, in 5 years	22.00
Overhead, Items 1, 2, 3, 4, at 12% per year	486.36
Additional cost of gasoline at 75% load factor	139.00
Total per year	$1236.66
Total for 10 years	$12366.60
Resale value truck, $100—resale value compressor, $100	200.00
	$12166.60

Two-Wheel Trailer Unit

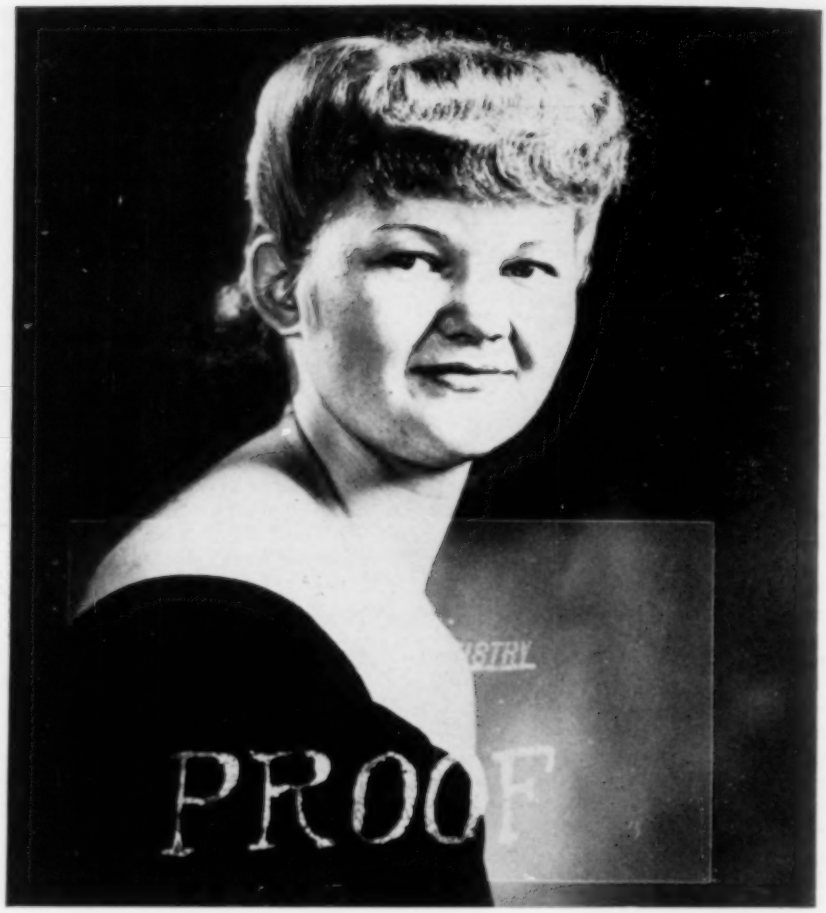
Depreciation, Item 6 Table Two, in 10 years	$377.50
Overhead, Item 6 Table Two, at 12% per year	450.00
Total per year	$827.50
Total for 10 years	$8275.00
Resale value truck, $100—resale value compressor, $400	$500.00
	$7775.00

Truck-Mounted Unit

Depreciation, Item 5 Table Two, in 10 years	$445.00
Overhead, Item 5 Table Two, at 12% per year	544.00
Total per year	$989.00
Total for 10 years	$9890.00
Resale value two trucks, $200—resale value compressor, $340	$540.00
	$9350.00

Why Amateur Portraits Look That Way

Edwin H. Jenkins



A LENS of long focal length, the ability to retouch or at least spot negatives, and the faculty to read light are essential to the making of good photographic portraits. If you take close-up portraits without having at least the first two qualifications, your friends will stop speaking to you and your wife may leave you. A lens may be had for $20 or less secondhand, if you know what to look for; and retouching and reading light can be learned by anyone in less time than it takes to learn a duffer's game of bridge. Still, very few amateur photographers can boast of even one of these accomplishments, while those having all three are so rare as to be practically nonexistant. Every owner of a good camera yearns to make something beautiful enough to hang on the wall, but usually succeeds in producing only album pictures. Lets see if we can't find out why.

Lets start with the camera. I venture to make the flat though general statement that no amateur camera, however costly, will turn out a good portrait. It won't for the same reason that an identification camera will not make a good portrait. Both are optically wrong for producing a good likeness of the human face, for if placed close enough to the sitter to fill the plate with his head and shoulders they will distort the features and, in addition, make a picture with poor drawing and perspective. Both have lenses of short focal length. The identification camera has a lens of this type to conserve office space and perhaps to speed production; the amateur camera, chiefly the kind where money is no object, has one for a variety of reasons such as compactness and adaptability. Whatever the price paid for it, the amateur's hand camera is a general-purpose apparatus capable of turning out pictures possessing little more artistic merit than those taken with a box camera. Like any Jack of all Trades it does few things well, and certainly was never intended for portraiture.

Nearly every amateur has no doubt noticed that his close-up portraits distort the features distressingly, whereas he sometimes gets pleasing likenesses in his full-length pictures. This is because he must get farther away in order to photograph a person full length. Therein lies one of the basic secrets of good portraiture. The conscientious studio photographer uses a long-focus lens—one at least twice as long as that normal for his film size—long enough so that it is never closer than 8 feet to the sitter's head. For all-around photography a lens with a focal length equal to the diagonal of the plate is considered ideal. This would call for a 6⅜-inch lens on a 4x5 camera. However, lenses of even shorter focal length are often supplied, one well-known 4x5 being equipped with a 5-inch lens. For good portraiture a lens of at least 12-inch focal length should be used with a 4x5 plate. Longer is much better, and in our studio we have a 20-inch lens. While greater care is needed in focusing it, the results are well worth the additional trouble.

To fill the plate with a sitter's head and shoulders, the camera with a normal-focus lens must be placed about 3 feet away from the face. This close proximity results in distortion of all the features, most conspicuously of the nose which, being nearest the lens, is magnified and made to look larger than it is. Also, at this distance, the camera, having only one eye, has an extremely narrow angle of view and does not "see" the sides of the head. A further important although relatively trivial factor is that the sitter is more camera-conscious and therefore harder to pose naturally with the apparatus thrust almost into his lap.

The essentials of fine portraiture are surprisingly easy to learn once the right start is made. And that's just the rub, getting started right—getting the low-down on the fundamentals. Portrait photographers are a cagey lot, and many a good studio has its jealously guarded secrets which not even employees are permitted to learn. Camera clubs sometimes hire professionals to talk on portraiture, but they invariably speak only in general terms and refrain from giving amateurs anything they can get their teeth into. Many stores handling photographic supplies do not encourage amateurs to buy or even look at professional equipment, and do not

THE MAGIC OF RETOUCHING

The portrait camera sees you as you are, with brutal faithfulness. It is the retoucher's job to hide skin blemishes, crow's-feet, baggy eyes, and doing such other odd jobs as straightening your nose, and removing any superfluous detail likely to attract the eye. The picture on the opposite page is a proof. The other shows the finished portrait made from the retouched negative and printed on soft "portrait" paper to increase its attractiveness.

These shutters are simple mechanical devices costing only from $6 to $15, according to size. They are standard for studio portraiture throughout the country and are operated with compressed air which, like gravity, is dependable and never fails.

Portrait work is strictly a hand process, machines being used only for washing and drying. Once the fundamental principles are grasped, it is as easy to master as are most other branches of photography. In order to make a modern portrait, a very sharp negative is required to begin with. It must have texture. The hair must be well defined, the eyes shiny and wet-looking, and the tiny veins in the iris, together with the dark circle surrounding it, should stand out clear and sharp. Even the pores should show in the negative. With proper darkroom procedure they appear in the final print as lovely, soft skin texture. The fuzz on the peach.

volunteer information concerning it. The departments handling amateur and professional goods are carefully segregated Such an attitude is understandable when one considers that the average amateur buys sheets of photographic paper by the dozen, while a studio orders them by the thousand, and all other supplies in proportion. The studio also has to purchase mounts, which usually cost more than all the other materials that enter into the making of a portrait.

The professional's approach to portraiture is simple and direct, and his tools, though frequently expensive, also are simple and direct. Go through any modern studio and you probably won't find anything more complicated than an egg beater. There are no gadgets—positively no gadgets, not even an exposure meter. The shutter is a marvelous contrivance that will do real tricks, but it is about as intricate and mysterious as a window shade. With a rubber bulb and a generous length of tubing, the photographer can stand in any position—in front of the camera, back of it, or 10 feet away; and simply by moving the fingers of one hand he can open the shutter and let it remain open, close it at will, and take a time, bulb, or instantaneous exposure all without loss of time fiddling with or even touching any part of it or the camera.

RETOUCHER AT WORK

The chief tools of the negative retoucher are a sharp knife or razor blade and two or more retouching pencils of differing degrees of hardness that are kept sandpapered to needle points. The negative is placed against the sloping ground-glass or flash opal-glass window of a stand having an interior light whose rays are directed back through the negative by a reflector. Noses and some other parts of the face are often made over by "knifing" away offending portions. Skin blemishes are removed with a pencil. Retouching obviously must be done painstakingly and skillfully, lest it destroy the likeness of the photographic image.

LOOK PLEASANT!

Although he is not behind the camera, but up near his subject where he can observe her expression closely, the author is actually taking a picture. In his left hand is a bulb that he squeezes to send a rush of air through rubber tubing to operate the shutter. There is no timing device or any other fancy gadget on the studio camera. The length of the exposure is controlled solely by manipulating the bulb. Approximately 1850 watts of electric lighting is being utilized. Directly above the camera is a 1000-watt flood lamp that is covered with a heat-resisting, glass-fabric diffusor whose purpose is to reduce glare. This softened glow is kind to the complexion, especially if it is on the blonde side. Directly in front of the photographer is an aluminum-foil paneled reflector that directs some of this light back upon the subject, insuring that both sides of the face will be illuminated. To the right of the camera is a 400-watt spotlight that is used as a general fill-in light. Over the subject's head is a 200-watt boom spotlight, with a "snoot," that high lights the hair. Behind the young lady, near the floor and hidden from the camera's view, is an open 250-watt incandescent lamp that brightens the background. The camera is more than 10 feet away from the subject, but its long-focus lens projects an image on the negative large enough to fill it with the head and shoulders.

Naturally, when you photograph pores you cannot avoid photographing skin blemishes and other unsightly things as well. Facial blemishes, even when not particularly disfiguring, will ruin any portrait because they distract the eye. When looking at a picture, the human eye has a tendency to concentrate on obviously superfluous details, thus preventing full appreciation of the image as a whole. A portrait with unsightly details may produce a feeling akin to irritation instead of pleasure in the beholder. Distress might be a better word.

If a portrait is to be good, the negative must be retouched—yes, even negatives of babies. Retouching is easy to learn. In our studio we teach girls to do it reasonably well in about a month's spare time. Instead of letting them stand around when there is nothing for them to do we give them rejected negatives on which to practice. That's the way they learn. Nearly every amateur has tried his hand at retouching at one time or another and given up simply because he didn't get results. What most of them never learn is that all roll film and nearly all other kinds commonly sold to amateurs cannot be retouched. Both sides are slick as glass, and varnish or no varnish simply will not take the lead. Professional film has a matte surface on the emulsion side which, after varnishing, will take lead as easily as does a piece of paper.

The tools required for the work are simple—a couple of pencils and a knife or razor blade constituting a complete outfit. If the needed equipment involved an expenditure of $50 or more, you may be sure that retouching would have been popularized long ago through advertising. Every wide-awake camera store would have someone around who could qualify as an expert. However, any amateur who doesn't want to learn retouching can make professional-looking portraits anyway. Many studios engage professional retouchers who do the work at home. They usually charge from 10 to 25 cents for a small negative and around half a dollar for a large one. Every sizeable town has one or more persons in the business, and they are usually glad to accept work from amateurs.

Every amateur knows that there is such a thing as retouching. Mighty few are aware of the advantages of a long-focus lens. Fewer still have heard about reading light. Here is a subject so utterly fascinating, opening as it does new vistas of sheer beauty and delight, that it is difficult to write about it with restraint. Having purchased a hand camera that is primarily designed for snapping pictures out of doors, the amateur takes his first pictures out of doors. Indoor photography is deeper stuff, and comes later. He learns to visualize the human face as it looks flat-lighted by the sun or a flash gun. So, no matter how perfect his pictures are photographically, he produces only snapshots; and the bigger he enlarges them, the worse-looking they become. He is blind. He has that peculiar form of blindness

that enables one to look at things with complete concentration and still not see. He cannot read light, and the ability to read light is as essential to portraiture as an edge is to a cutting tool.

On the subject of reading light I should by now be able to speak with some authority. Once a week I receive a 2-hour lesson from the world's finest portrait artists. So can anyone else willing to spend the price of a movie ticket. I relax through the newsreel and shorts. What I'm there to see is a Grade A indoor black-and-white movie with big-name stars. Those stars are valuable property; and in the close-ups, master artists will be certain to employ every trick of lighting in order to make their faces appear lovelier than they really are. All there for me to see for only 50 cents. It's a bargain.

I can read light, and so can any amateur if he will look and see at the same time. Snapshots are made outdoors, while portraits are invariably made indoors. We are all so accustomed to looking at people indoors that we never notice that one side of the face is nearly always in shadow and therefore darker than the other. We gaze at the beautiful close-ups in the movies and never notice that the faces are invariably bright on one side and dark, even dead black, on the other. Oftener than not there is a triangular-shaped light like an inverted pyramid under the eye on the dark side of the face. Look closely and you will perceive that on the bright side there is no nose. It simply merges into the cheek, the nose being formed by the shadow on its dark side. Follow the usual amateur custom and photograph a face with both sides bright and there will be no nose at all, only a couple of nostrils. The face will look flat, too, and lack third dimension. Looking for and seeing the shadows and their shapes is all that there is to reading light. The camera will record them just as you see them. It's as simple as that.

A lens of long focal length, the ability to retouch or at least spot negatives, and the faculty to read light are, as we have said at the outset, essential to the making of good photographic portraits. Few amateurs have even one of these qualifications. Not one of my acquaintances, and I have a great many, possesses any two. Some professionals don't either, so don't feel too badly if you happen to be an amateur photographer, as I suspect you are if you've read this far. So long as this condition obtains, amateur portraits will continue to be in a class by themselves and the amateur's efforts will continue to stimulate the studio-man's business.

THE AIR BRUSH

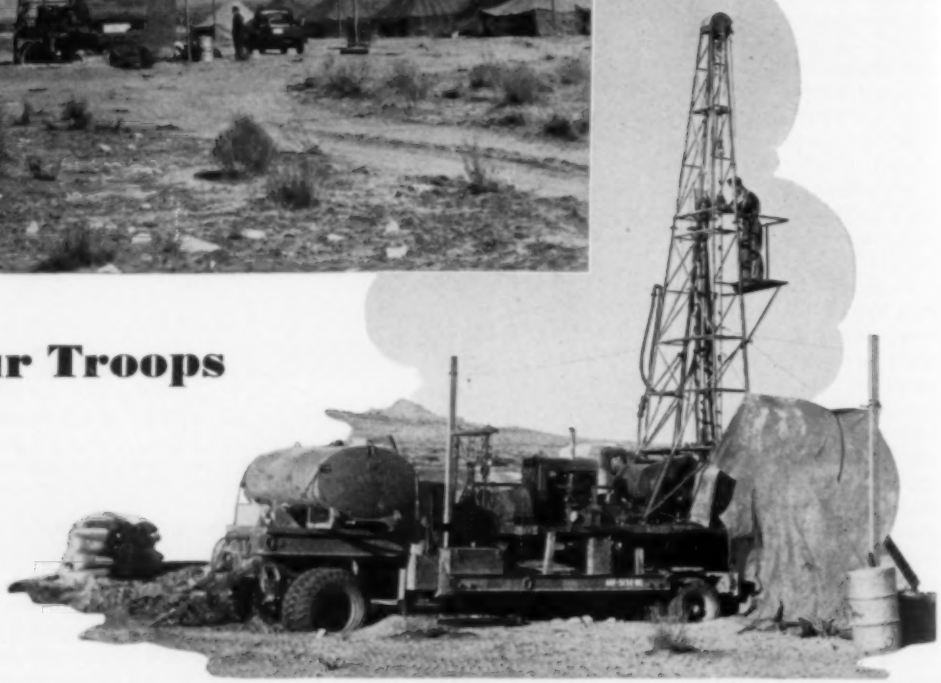
Not all studios employ an air brush, but it is useful for high-lighting and working up backgrounds on negatives and also for applying color on prints.

EFFECTS FROM DIFFERENT LIGHTING

The picture at the left was made with "flat" lighting, obtained entirely from fluorescent lamps. The center one had "three-quarter" lighting. One side of the head is well illuminated, but the other is in shadow because no reflector was used. The right-hand picture was taken with full studio lighting, as shown in the view on the preceding page. These pictures are in no sense finished portraits, but were made solely to show the importance of correct lighting.

Water for Our Troops

Daniel Frost



All photos—U. S. Engineers

DESERT TRAINING CAMP

At the top is a general view of the camp near Kingman, Ariz., where water-supply battalions are trained for overseas duty. The other picture shows a drilling rig mounted on an Army-truck trailer. The tank at the left is for water. The tubular-steel derrick or mast is hinged so that it can be laid flat over the top of the other equipment for transportation.

BAD water and good strategy can never win a war. Bad water can wipe out troops as completely as a concentration of enemy fire. And the enemy, knowing this, destroys as thoroughly as possible all available water supplies in any theater of operations he must evacuate.

Although this is an inconvenience, it matters little to our invading armies, for the U. S. Army Engineers, who have water-supply battalions attached to every combat branch of the service, move right in with the advance units. These engineers can set up a well-drilling rig, put down a 100-foot well, case it, set a screen, wash out the hole, swab and develop it, and be pumping enough water to supply a division within five hours!

Such speed and efficiency are the result of a far-sighted training program, with headquarters located in one of the most arid sections of the United States, near Kingman, Ariz. There enlisted men are instructed in the Army's methods of drilling for water. It takes about eight weeks to teach an experienced driller, and four times that long or longer to instruct an inexperienced one.

The soldier first learns that any successful system of drilling wells must provide a means of penetrating subterranean water-bearing formations. To do this, a rotary or percussion drill is used. The percussion drill predominates in civilian well-drilling, where most driven wells are necessarily shallow and of small diameter because of the difficulty of driving large pipe to great depths. In consequence, percussion-drilled wells seldom supply sufficient water for combat troops and equipment in the field. While a rotary drill is more costly to operate than a percussion drill, expense is given the least consideration when lives of men on a battlefront are in question.

Again, with a rotary, a test hole can be drilled as a prospect in a doubtful or unknown territory (certainly the case in newly captured terrain), and if the result is poor, the hole can be abandoned with a minimum of trouble without the necessity of pulling casing or leaving one or two strings of casing in the hole. Too, the rotary can pierce alternating hard and soft formations with less danger of accidents than can the cable tools. And finally, the rotary does not tend to "freeze" when drilling through sticky shale, clay, or quicksand as do the cable tools. However, some percussion drills are used by the Army where shallow drilling is in prospect, where rough country is to be traversed and a light rig is desirable, or where little water is available for drilling operations.

At Kingman, however, the Army places emphasis on the use of the rotary drill. The new men are taught the nomenclature of the rig and learn how to dismantle and reassemble it. They next become thoroughly acquainted with every part of its mechanism. They learn that the hoisting drum and sand reel are known as the "draw-works," and that the first of the two winding drums is used to lower drill rods or pipe and the other to bail or swab fluid from the hole when developing the well. Then the hydraulic cylinders for applying pressure to the drill bit and the hydraulic cylinder for moving the rotary mechanism to and from the drilling position are taken apart and inspected. The engine—a water-cooled gasoline type developing 35 hp. at 1600 rpm.—also receives its

share of study. Power is transmitted from the engine to the drill head through a clutch and selective speed transmission. On the front end of the crankshaft is attached a pulley that drives the mud pump and the hydraulic oil pump.

During this preliminary course of study the soldier learns which parts of the drill are most likely to wear out and how to make quick repairs in the field. Finally, he is taught how to handle the drill under power, to manipulate the various levers and controls, to make the drill rotate idle, and to pick up light weights with the hoisting arms. Then comes instruction in drilling technique.

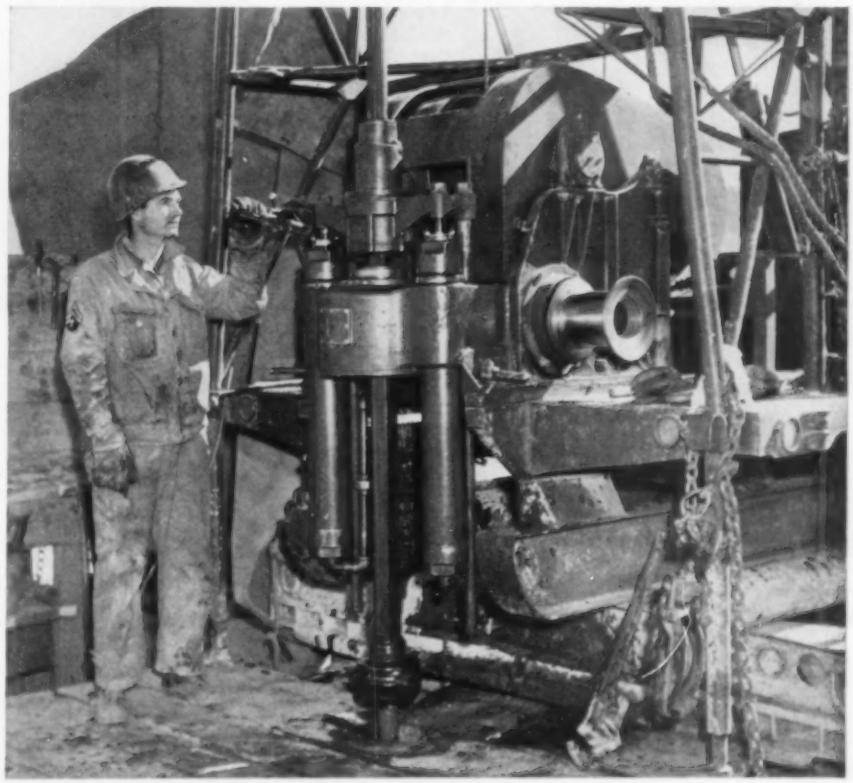
A circulating fluid of mud is employed for excavating the loosened material from the well as drilling proceeds, and it must be mixed to the proper consistency. A settling pit, a main pit, and a connecting ditch must be provided for the circulating fluid. An important function of this mud circulation is its action of depositing small particles of clay on the wall of the well so as to seal off porous formations against loss of fluid.

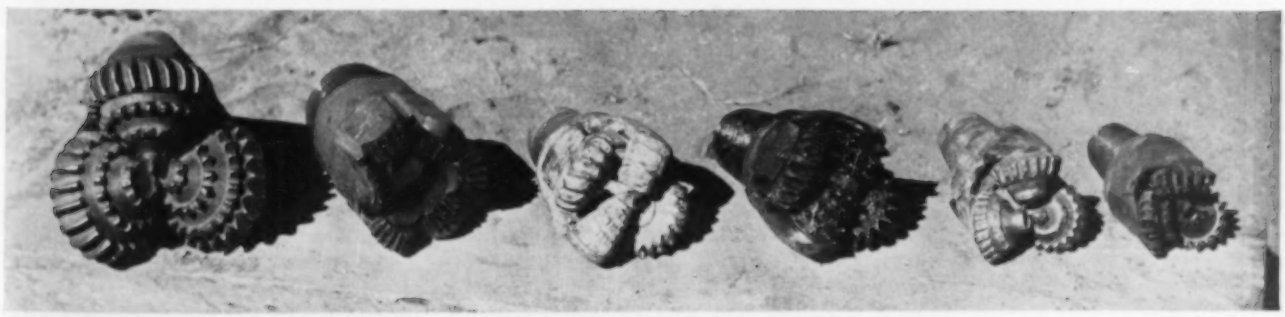
Many types of bits are used, each designed for a particular kind of formation. The men learn to identify the different formations through which the bit is cutting by listening to the sound coming from the hole. Cutting through clay, for instance, makes very little noise, while harder rock formations give off a definite ring. But when the bit cuts through sand, where water is usually found, it chuckles. Also, by feeling the vibration of the drill stem, the soldier learns that valuable information can be obtained as to the type of formation being drilled. This is most important, for under battle conditions there is little or no time to take core samples to determine the depth of a water-bearing sand formation, and the Army well driller must be able to identify these strata by the means mentioned.

Once a water-bearing formation is located, drilling is finished, although there is still considerable work to be done before the well can be used as a source of water for troops in the field. First, the crew must remove the drill stem and select the proper screen. Working against time—a vital factor in the field—they set the screen, case the well with pipe, and then wash it out with clear water. Next they bail it out and install a deep-well turbine pump. Finally, an air line is put down to check "draw-down." This last is important in an actual theater of operations, for it is necessary that the engineers have a comprehensive understanding of the draw-down of the ground-water table to estimate how many more wells will be needed later for a larger supply.

The drilling machines used for training are identical with those that are in operation in the combat zones throughout the world. And even though the redesigned rotary machine (adapted especially for Army use) has been in service less than two years, both it and the percussion drill have done rugged work and given excellent results. The former can speedily drill a small-diameter well to a depth of 1,000 feet—no mean accomplishment for equipment that can be transported on a standard Army 6x6, 4-ton truck. Fifteen men, two more trucks, a water tanker, and a reconnaissance car complete the unit that can operate the drill on a 24-hour basis near enemy positions.

Although these well-drilling rigs are but one of many types of technical devices the Army has developed to facilitate the waging of war against our enemy, they are certainly one of the most important. For of all the supplies that must be furnished the soldier at the front, the most essential is water. And this is equally true of machines. Tanks, half-tracks, jeeps, and trucks need no "K" rations, but they do need water.





DRILL HEAD AND BITS

Two hydraulic cylinders on the drill head are the means by which downward pressure is exerted on the drill rods as the latter are rotated. The pistons are shown at the bottom of their stroke. A technical corporal has his hand on the control lever. The bottom view shows various types of bits, some new and others worn, that are used for rotary drilling.

FIRE FROM A PRIMITIVE AIR COMPRESSOR

A scene in a Tinguian village of Luzon, Philippine Islands, as painted by Amos Sewell to depict the "mystery match" of Luzon. The woman firemaker holds in her left hand a small cylinder of buffalo horn having a round hole extending part way through it. In her right hand is a slender, hardwood piston with a knob on one end and a recess for dry palm-scurf tinder in the other end. She has just driven the piston into the cylinder with a sharp blow and withdrawn it with the tinder glowing. The heat generated by the compression of air has ignited it, and she is blowing the glow into flame. This is one of a series of paintings made by Mr. Sewell to portray the history of fire for the Universal Match Corporation, through whose courtesy it is reproduced.

The Oriental Fire Piston

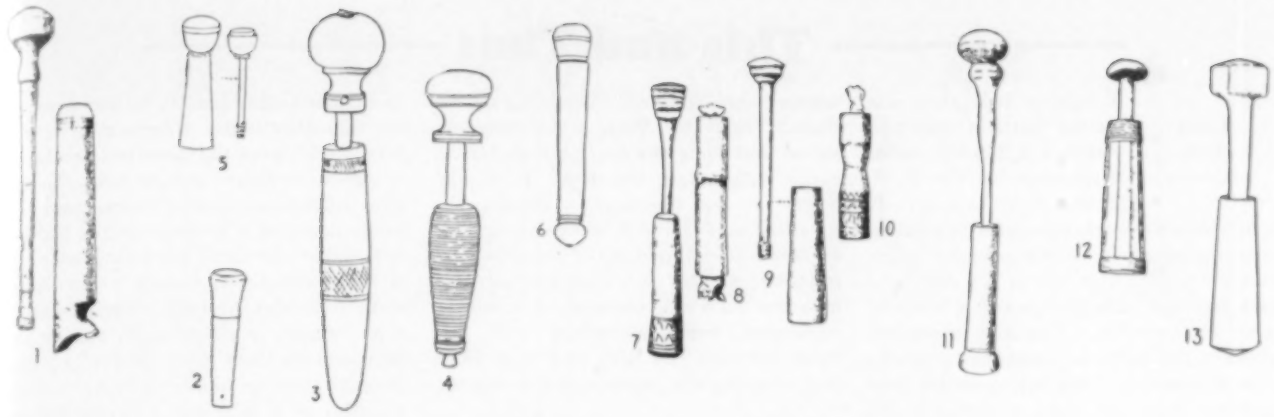
HEAT generated by the compression of air was used by primitive Oriental peoples to light fires. Their compressor was a small cylinder of wood or horn, hollowed out to receive a plunger or piston of similar material. One end of the piston was enlarged or fitted with a knob, while the other end was recessed to hold tinder. The piston was placed in the open end of the cylinder and then struck a sharp blow with the hand or fist to drive it home. The heat that accompanied the resultant air compression ignited the tinder, which glowed when the piston was withdrawn and was blown upon with the breath to fan it into flame.

This simple, but nevertheless delicate, device was called a fire piston. It was used in sections of a widespread area extending from Burma and Siam down through the Malay Peninsula to the Dutch East Indies and northward to Luzon and Mindanao islands in the Philippines. Numerous examples of it are housed in museums, and ethnologists are still trying to solve the mystery of how such a semiscientific apparatus came to be invented in an environment of relatively low culture. Kindred devices were employed in Europe early in the last century, but there is no evidence that they were transplanted to the East.

The European version of the fire piston was adapted from a scientific toy that had been designed to demonstrate that the compression of air produces heat. Around 1802, the French scientist Mollett, professor of physics at the Central School in Lyons, altered the instrument to make what he called a *tachpyrion* (meaning swift fire). In general, it was like the Oriental fire piston, but was made of metal and had several small holes in the bottom of the cylinder to permit the heated air to be expelled onto quick-igniting tinder outside the barrel.

Almost at the same time, Richard Lorentz was issued a patent in England on a similar device. Not much use was made of the apparatus in either France or England, as the flint-and-steel method of fire-making was in common service. It is improbable, therefore, that the fire piston was taken to the Orient by traders —first, because none made of metal has ever been found there and, second, because none of the primitive specimens has holes in the bottom of the cylinder, which was a feature of both the French and English models.

The Oriental or Malay fire piston was



EXAMPLES OF THE FIRE PISTON

These specimens, which exhibit a variety of shapes, materials, and ornamentation, are now in European museums. Origin: 1, 2, Borneo; 3-5, Java; 6, Flores; 7-13, Philippines. The large knobs on some of the pistons are hollowed out to hold a supply of tinder. The illustrations are from "The Fire Piston," by Henry Balfour.

much the same wherever it was found, although it varied somewhat in shape and refinements, as the accompanying illustrations show. The cylinder was ordinarily from 3 to 5 inches long, overall, and the interior bore around ¼ inch in diameter and from 1¾ to 4½ inches deep. The slender plunger was made to fit the opening closely and was sometimes wrapped with fiber thread to reduce the clearance. The tinder was usually held in the recessed end of the piston, but occasionally it was placed at the bottom of the cylinder and some sort of a hook was provided for withdrawing it after it was ignited. Palm scurf or other vegetable material served as tinder.

Henry Balfour, curator of the Pitt-Rivers Museum at Oxford, England, has made an extensive study of these fire pistons, and some of the facts that follow are taken from one of his papers on the subject. In Burma, the pistons are associated principally with the Kachin people. The cylinders were of bamboo or horn and the pistons of wood or horn, or a combination of both. In Java the cylinder seems to have been characteristically cigar-shaped and was often ornamented with engravings. In some instances the knob on the piston head was hollowed out to hold a supply of tinder, and a few examples even have a lid fitting over this opening. The Sundanese fire piston of West Java was called *tjeletok*, meaning struck down quickly or with force. The word has the same root as *tjatoew*, the Malayan name of the instrument in Sumatra.

The wild non-Negrito tribes of north-central Luzon appear to have been the chief users of the fire piston in the Philippines, although examples have been reported from other ports of Luzon and from Mindanao. In all these localities the apparatus was usually made of carabao (buffalo) horn, and was frequently called a fire syringe. The Tinguian people of the Bontok area used grease to lubricate the piston and carried the fire-maker, with a supply of lubricant and tinder, in a woven pouch. A traveler reported that the natives prized the equipment highly and demanded something of value in exchange. Europeans who observed the natives making fire with one of these pistons agreed that long practice was necessary to perform the operation successfully. One of them, D. C. Worcester, who wrote about the Philippine Islands in 1898, stated: "I have yet to see a white man who professes to be able to do it."

The amount of heat that could be produced with this device depended upon how high the air was compressed, which resolves itself into how hard a blow the user could strike. Theoretically, if air at 60°F. is compressed to 50 pounds gauge pressure by single-stage compression it is heated to 339°, and when compressed to 100 pounds the temperature is 485°. A good grade of lubricating oil will flash at from 375-400°, and it is probable that dry, fluffy tinder will ignite somewhere near the same temperature range. It is also likely that additional heat was developed through friction.

It is interesting to note that the principle on which the primitive, mystery-clothed fire piston is based is the same as that upon which the modern diesel engine depends for its firing action. Through this parallel the paths of men of dissimilar periods of civilization cross in strange fashion.

Dam Built to Resist Earthquakes

NOW under construction on the Santa Eulalia River at a point 50 miles east of Lima, Peru, is a dam that will be somewhat unique because it has been designed to withstand earthquake shocks. At the site of the structure, the river flows through a crack in the mountains that was apparently caused by a seismic disturbance. The chasm is approximately 1300 feet long, 500 feet deep, and from 18 to 65 feet wide. There the dam is being reared on a solid concrete plug that extends down to bedrock 55 feet below the bottom of the stream and up between the rock walls to a height of 90 feet. This foundation is roughly quadrangular in cross section.

The Autisha Dam, as it will be known, is being built in the shape of a butterfly, the wing sections being separated by a space 6 inches wide and 10 feet long. The closure of this interstice—the body of the butterfly—is the key point in the design and will, it is expected, permit the two monoliths to move without cracking during an earthquake. On the upstream side, the opening is closed by a length of iron pipe, 10 inches in diameter, filled with concrete. This pipe rests against two vertically disposed I-beams set in the face of the dam and will be forced into the 6-inch space by the pressure of the impounded water. Halfway through the 10-foot-long gap is a shaft or well on the downstream side of which is a V-shaped copper expansion joint that closes the space between the two wing sections. This flexible sheath will prevent the passage of any water that may seep past the pipe and the shaft, which will also give access to the interior of the dam.

The project is to be constructed in two stages. At the present time the barrier will rise 256 feet above the river bed and will impound about 396,300,000 gallons of water. Later, when demands justify, it will be heightened by 72 feet so as to create a reservoir with a capacity of 2,377,530,000 gallons. A diversion tunnel nearly 2 miles long will carry the water under a head of 915 feet to the power house in the valley below. When completed, the plant will develop 30,000 kw. The total cost of the undertaking, including connecting highways, is estimated at between $5,000,000 and $6,000,000.

This and That

Long Belt Service

A rubber belt that has run for fourteen years and traveled 1,200,000 miles is reported by The B. F. Goodrich Company. It is driving an electric generator in a stone-crushing plant, the power source being a steam engine. The belt is 105 feet long and has not changed position since it went into service. The only attention given it has been an occasional application of dressing. The belt operates nine hours a day, six days a week, seven months a year. It travels at the rate of 52 miles an hour. The pulleys over which it runs are 11 feet and 2.83 feet in diameter, respectively.

★ ★ ★

Cold Storage Afloat

Floating refrigerator storage houses built in California and knocked down for shipment are one of the war products that are a ceaseless source of wonderment. The barges were designed by the National Iron Works in coöperation with Army engineers and are now in mass production. They are fabricated of steel; are 104 feet long, 29 feet wide, and 8 feet deep; and are equipped with Freon refrigerating systems. Each is made up into 368 packages, which require ten box cars and gondolas to transfer them to the point of embarkation, and is accompanied by specific directions and tools for quick assembly, as well as with paint, which is applied after completion. With a carrying capacity of 400 tons each, the vessels can operate without refueling or rewatering for three months. They are designed for service mainly in the South Pacific where runs are long and where climatic conditions are such that perishable foodstuffs would spoil quickly if not kept in cold storage. Quarters are provided for a crew of four men.

★ ★ ★

Mouse Plugs Tube

The facilities for dispensing police news to reporters in Brooklyn, N.Y., are very modern. Reports of crimes committed throughout the borough come into the fifth-floor headquarters by teletype. From there, copies are dispatched by pneumatic tube to the first floor, where an attendant extracts them from a container and hands them to the newsmen assigned to the beat. One day recently there seemed to be a paucity of reports, and when they did arrive at the first floor they told of transgressions that took place several hours before. The reporters, who look upon a 3-hour-old fact as history and not news, griped about this and even accused the attendant of holding out on them. The latter, Vincent Giovanni, insisted that such was not the case, but he could not explain the delay in the delivery of the messages. Finally the mystery solved itself when an unconscious mouse popped out of the tube. The rodent evidently had inadvertently got into the tube and become an unwilling passenger, being whooshed back and forth between the fifth and first floors and blocking the passage of the reports.

★ ★ ★

Killing Rabbits with Gas

Gasogene units such as are used to generate fuel for automobiles in many countries are being employed in Western Australia to rid the region of surplus rabbits. The gas, which contains a high percentage of lethal carbon monoxide, is generated from charcoal. An engine-driven fan forces it through flexible metallic tubing into the warrens. The entire outfit is mounted on a small truck that is moved about as desired. These units are enabling farmers for the first time to deal effectively with the rabbit menace.

★ ★ ★

The Oily Outlaw

Chemists in the Richmond, Calif., laboratories of the California Research Corporation have produced a lubricant that is said to thicken when heated and to thin when cooled. It is referred to as the Oily Outlaw because it was first developed on paper. By combining an Einstein equation with a Staudinger equation it was proved that a suitable high-velocity material, when added to lubricating oil, would dissolve when heated, thickening the lubricant and contributing greatly to its viscosity. On the other hand, a drop in temperature would cause the dissolved substance to again combine and to thin the oil. The additives—mostly resins that are many times as viscous as the oil itself—are finely divided particles, each of which is composed of only a few thousand molecules. At ordinary temperature they remain in suspension, but as the temperature rises they gradually break up until they are finally reduced to about the size of a molecule. When the lubricant cools they become particles again and the oil returns to a state of low viscosity. It has been pointed out that the Oily Outlaw is still a laboratory curiosity, but the hope is expressed that it may be a step toward the ideal lubricant for equipment that must operate in widely varying temperatures.

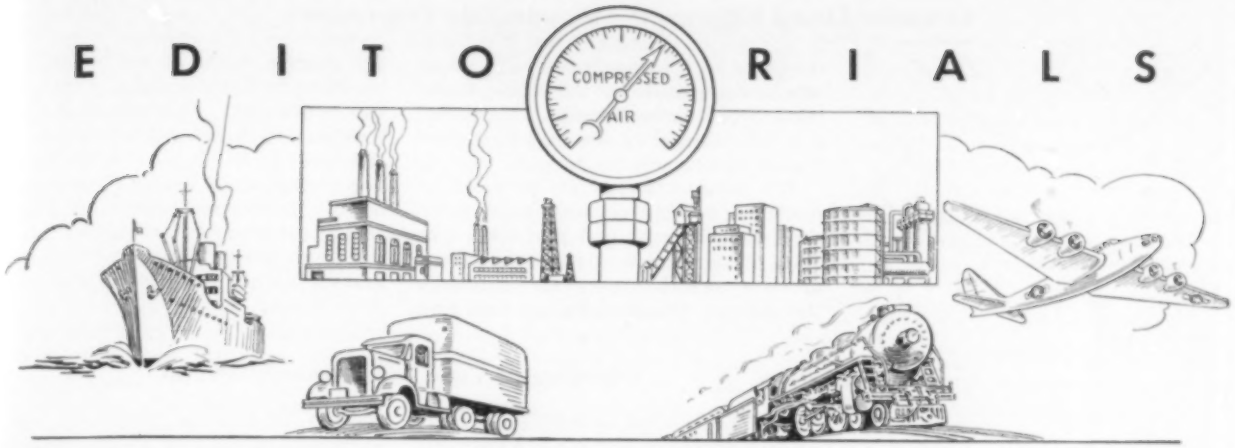
"Are you the new man?"

★ ★ ★

Great Bell of Moscow

The casting of bronze bells was an art that commanded the interest of foundrymen down through the ages, starting in pre-Christian times. The earlier bells were small, but gradually their size was increased, especially after the eleventh century, A.D., when a bell weighing 2600 pounds was considered remarkable. This trend continued until it was climaxed by the casting, at the Royal Russian Gun Factory, of the 220-ton great bell of Moscow, a work that required three years to complete. The initial pouring took place in November, 1734, with four reverberatory furnaces being used to melt the bronze. On the 26th, 100 tons of metal was charged into them, and this was followed the next day by additional charges of 90 and 36 tons. Two of the furnaces failed under the weight, and the molten metal went through their bottoms. More metal was obtained, including 74 tons of copper coins, and charged into the two remaining furnaces. On the 29th these also failed, and the building caught fire from the molten metal and was destroyed. John Motorin, the foundry foreman, died from worry over this chain of unfortunate events, but his son took up the unfinished work and succeeded in casting the bell on November 23, 1735. However, while preparations were in progress for removing the bell from its pit, a fire swept through Moscow and the building was destroyed. The heat cracked the bell in eight places; and one section, weighing ten tons, fell out. The bell was 19¾ feet high, 60¾ feet around the bottom, and had walls ranging from 6 inches to 2 feet in thickness. The cost of making the mold alone was nearly $48,000.

EDITORIALS



STANDARDIZATION PROBLEMS

IT SEEMS impossible that such a minor thing as the way threads are cut on a screw could cost $100,000,000 during the war, but that is the official estimate to date. This monetary waste is one of the reasons for the Anglo-American conference that has just been held to consider the standardization of screw threads and cylindrical fits. A more serious reason is that differing screw-thread designs have caused no end of trouble on the battlefronts, keeping vitally needed machines out of action. Although some guns and other war products made both in England and America are of identical design, their individual parts are in many cases not interchangeable. As a result, vast stocks of duplicating replacement parts have to be maintained in the various theaters of war.

The divergence in thread patterns goes back a long way. When the industrial era was in its infancy, nearly every manufacturer had his own design. Scarcely any two of these were alike, and replacements had to be made to order. More than a century ago, Henry Maudsley started a standardization movement in England, and his work was carried on by Sir Joseph Whitworth, who offered the first standard form and series of pitches in 1841. Great Britain and Russia adopted the Whitworth system, and it also came into considerable use in the United States. However, William Sellers took exception to it in 1864 and introduced some ideas of his own. The Sellers design seemed simpler and easier to manufacture, so American industry adopted it. During ensuing decades there was also some scrambling of designs in other nations.

When our manufacturers got into war production and began to make parts for foreign machines they ran into a maze of trouble. They found that they had to have different taps, dies, and gauges for French, British, and Russian screws. One of their greatest difficulties was encountered in the production of the rounded top of screw threads, because the necessary tools were very hard to get. The Army engineers simplified matters to some extent by designing a flat-topped Whitworth thread that was accepted in Britain, but there still remained points of variation. In an effort to iron them out, missions from the two countries have had numerous meetings and have issued a report that is being distributed in the respective nations.

Important as it is, the screw-thread mix-up is a minor headache compared with the confusion caused by the different systems of weights and measures used among nations. The metric system is concededly simpler and more workable than any other now employed or so far proposed, and there is increasing pressure to make it the universal standard. It would cost millions of dollars for us to make the change, but most engineering authorities are of the opinion that it will have to come some day and that we might as well take the step as a part of our postwar readjustment.

•

KEEPING THEM GOING

OUR newspapers bring us many accounts of the supposedly ingenious flare of American fighting men for fixing up damaged or broken-down battle equipment so that it will give additional service. Granted that there is a lot of Yankee ingenuity displayed in such instances, most of these makeshift repairs in the field are the result of organized training in maintenance work. It doesn't just happen that a man with previous mechanical experience and a kit of tools is usually around when a piece of equipment breaks down; he is there by design, because it was planned that way.

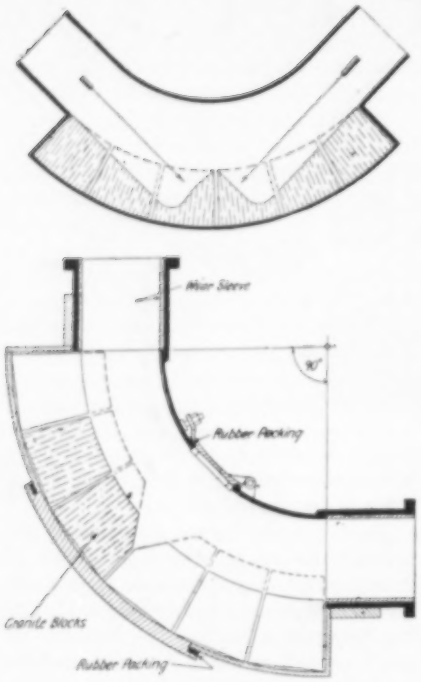
When field forces are operating thousands of miles from factories, capable maintenance men are worth their weight in gold. By keeping machines running, they not only help turn the tide of battle but save untold man-hours on the production front, precious space in ships, and, overshadowing these considerations, the time that would be required to get replacement machines to the battlefront. In modern mechanized warfare, adequate maintenance of fighting equipment is a necessity.

Here at home we are also getting our wartime lesson in the importance of maintenance, and it extends right down to the individual. Some of us are learning things the hard way. Because we can't go out and buy new automobiles at will, we are taking good care of our old ones, knowing full well that if we don't we will be spending a lot of time waiting for or riding in buses, street cars, or trains, and adding to the overcrowded conditions that prevail on these conveyances largely because many of the passengers failed to take the maintenance stitch on their own cars in time to keep them on the road. Similarly, we are watching over household appliances more carefully than was our habit, lest we also go without these conveniences.

On the industrial front, maintenance is likewise getting increased attention. Factories have always practiced maintenance to some degree, but many of them are discovering that they formerly did a poor job of it, compared with the practices that have been imposed upon them by the restrictions of a wartime economy. Like the private motorist, they, too, have to maintain machinery and equipment because they ordinarily can't replace them. The old viewpoint that maintenance is a necessary evil and something to be done during slack periods of production to give workers employment has disappeared. Regular maintenance gets front-office attention now, and in many plants its importance ranks right up with production.

This new conception of systematic inspection, repair, and replacement of wearing parts is destined to carry over after the war. We are slowly awakening to the realization that our natural resources are not, as we once thought, inexhaustible. We are beginning to be pinched for some materials already, and the war has taught us to make substitutions. Studies to determine how we can more effectively use what we have must be included in research programs.

Granite-Lined Elbows for Pneumatic Conveyors



LINED WITH GRANITE

The drawing at the bottom shows the details of the novel elbow for pneumatic and hydraulic conveyor systems. The notch in the center of the arc soon fills with material, which is then carried away as the granite face is worn down in service. As originally designed, the inner contour was smooth and circular. When that elbow was reversed, as is common practice, a step was formed through attrition, as indicated at the top. This interfered with the free flow of the material and caused choking of the line.

ELBOWS in pneumatic and hydraulic conveyor systems have generally been a source of trouble because the material passing through the tubes impinges against those sections, necessitating more or less frequent renewal. Wear and tear is especially high if the material is hard and abrasive and carried at high speed. Different measures have been proposed and tried; but high-grade steel linings have so far proved most satisfactory, even though they do not always add appreciably to the service life of the bends.

Now we learn that certain collieries on the Continent, because of a lack of alloying metals, are using granite blocks instead of steel with surprising results. The granite, according to *The Iron and Coal Trades Review*, is cut into trapezoidal blocks to form the outer curve of the elbow and are locked in place by a pressure bar and nuts and bolts. Measured from the center of curvature, they have a maximum thickness of 4¾ inches and are generally notched or troughed to lessen attrition and to prevent choking of the system. Obviously, initial wear with such a bend is greater than it is with manganese steel, such as was formerly used; but it has been found that, after a certain amount of attrition, a point is reached where the surface remains practically unchanged.

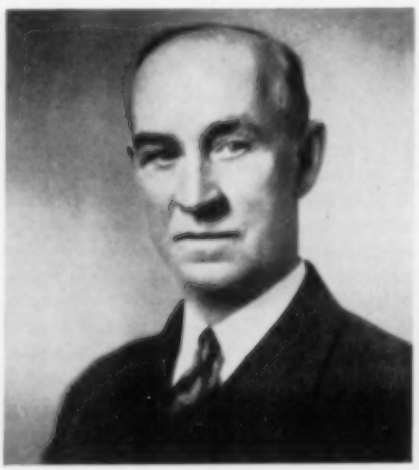
The granite linings are reversed at intervals the same as steel linings to insure uniform wear and maximum life. Wear of course depends upon the material conveyed and its rate of travel through the system. Comparisons between steel and granite, to be of any value, must therefore be based upon a given elbow and conditions. The following figures were arrived at under such circumstances and apply to 45° elbows. With all things being equal, steel linings, it is claimed, had to be renewed after from 7850 to 10,460 cubic yards had passed through the pneumatic conveyor, while the granite linings were good for 20,927 cubic yards.

Packaged Coal for Household Use

WHITE COAL is another name for waterpower and is a translation of *houille blanche*, as the French picturesquely call electricity generated by falling waters. But "white-glove coal" is something else again. It's packaged coal for household use that is so clean that it can be stacked anywhere and handled without getting dirty. Made in the form of briquettes from fines that were formerly wasted, we are informed by the U. S. Bureau of Mines that thousands of tons of this fuel is now being burned annually. Fourteen states have plants engaged in the business, some operating just as a side line. Manufacture is near the points of consumption to obviate long hauls and rough handling.

A plant with a capacity of 150,000 tons of briquettes a year is being built in Philadelphia, Pa., and is to be operated by the Blaw-Knox Company. It is sponsored by the War Production Board as a measure to relieve the lump-coal shortage and to make use of surplus fines. The material will be pressed into 3x3x3-inch blocks, consisting mostly of anthracite, a small percentage of bituminous coal, and an asphalt binder. They will be wrapped in paper in groups of six weighing 6½ pounds. Placed in a furnace or fireplace, the fuel should not be disturbed until the outer part has coked, is a fused mass. From then on it burns just like lump coal and should be treated as such. If the market for the product justifies, the company plans to erect additional plants elsewhere to meet the needs especially of those who can buy coal only in small quantities because of economic circumstances or lack of storage space.

To Be Honored by Construction Group



WILLIAM V. McMENIMEN **FRANCIS T. CROWE**

The annual awards of The Moles, New York organization of tunnel and heavy construction men, for "outstanding contributions to construction progress" will be made in New York on February 7 to the two men pictured above. Mr. McMenimen, a member of The Moles, heads a group of eight contractors that has built Pacific Island naval bases costing $1,250,000,000. He began his construction career by superintending the driving of the McAdoo Tubes under the Hudson River in New York Harbor, and is now general manager of the Raymond Concrete Pile Company. "Frank" Crowe is generally acclaimed as the builder of Boulder Dam, having been superintendent for Six Companies Inc. He also directed the construction of Parker and Shasta dams. For many years he was with the U.S. Bureau of Reclamation, and during the erection of Arrowrock Dam in Idaho he designed a then unique pipe-line system for the pneumatic conveying of cement.

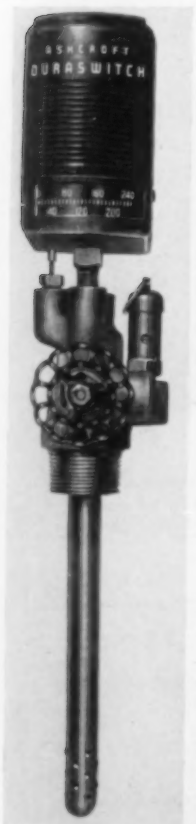
Industrial Notes

Dupont's flexible air duct known as Ventube has undergone improvement, according to a recent announcement. It is made of an impregnated material and of a tempered-wire helical spring that keeps the tube distended. The fabric is said to be water- and airtight and to resist abrasion, heat, mildew, and dry rot.

Compounded initially to seal threaded connections, Key Company has discovered another use for its graphite paste. It claims that parts coated with the substance before heat treatment will come from the furnace with a graphitic residue that prevents scale formation. The film is easily removed by hand or power brush.

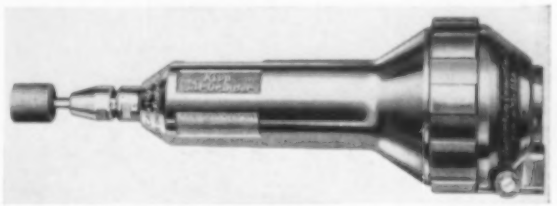
Zippers with a waterproof closure that is said to prevent the escape of air or other gases are a product of The B. F. Goodrich Company. They come in several styles with overlapping rubber lips that resist temperatures from -70 to +150°F. and assure a seal against any pressure that the slide is built to withstand. The fastener bears the name Pressure Sealing Zipper.

In one small, compact unit, Manning, Maxwell & Moore, Inc., has combined seven devices for the control of receiver-mounted compressors ranging in size up to 15 hp. or 60 cfm. The instrument is known as the Ashcroft Compressor-Trol and eliminates the use of pipe and pipe fittings, thus lessening the possibility of air leakage. It consists of a series of valves, a removable pressure switch and gauge with either an electric or mechanical attachment for operating a 2-way unloading valve, and of a muffler that delivers the compressor discharge into the receiver where it serves to diffuse the air to reduce its temperature and moisture content before delivery to tools or equipment. The Duraswitch and gauge has a heavy-duty gearless movement, slide-rule dial, self-draining and non-freezing Bourdon tube, and comes in all standard pressure ranges. Compressor-Trols are made in three sizes—for ½-, ¾-, and 1¼-inch inlet connections.



For laboratory, industrial, and field use, the Chief Chemical Corporation has developed an apparatus for analyzing water that is said to give consistently precise results in far less time than the customary gravimetric methods. The Aero-Titrator, as it is named, employs a new end point that is based on the foam-meter principle. According to the manufacturer, this end point is unmistakable and reproducible with accuracy; and determinations of hardness, calcium, and magnesium are made within ten minutes without the need of waiting to observe stability of lather. Samples of 50 milliliters or less are sufficient, as against the ½ liter or more generally required; and agitation is effected with low-pressure air instead of fatiguing hand shaking. Substances ordinarily present in water do not interfere with direct titration—chlorides up to 2000 ppm. (parts per million) and sulphates up to 1000 ppm. being without effect. In fact, microdeterminations of calcium and magnesium in boiler scale, minerals, plant ash, rocks, sediments, etc., are easily made in the presence of practically all the impurities in the samples. The instrument has no moving parts to wear out and no delicate features to go out of adjustment. It comes calibrated and ready for assembly and use.

Madison-Kipp Corporation has recently announced that it is manufacturing an improved type of air grinder—the JA—that was planned as a postwar product. It is of extreme lightness (12 ounces) which is made possible by the use of aluminum and magnesium that have been made available for public use. The tool is described as new inside and out. It has an over-all length of 6½ inches and can be taken apart for cleaning by the removal of one lock screw and nut. The standard model runs at a speed of 50,000 rpm., which is controlled by a new sleeve-type governor. Air at from 30 to 120 pounds pressure can be used to operate it, and air consumption is said to be low. The shaft of the JA is mounted on two special high-speed ball bearings and is of larger diameter than that of the former models. This increase in size gives the tool greater stability which, it is claimed, results in smoother running, more efficient grinding, and longer grinding-wheel life.



Stickers that can be applied to metal, glass, plastic, wood, or any other smooth surface without moistening and that can be peeled off readily when no longer needed are offered in stock sizes by Avery Adhesives. Each is imprinted with one of three words—Rework, Rejected, or Accepted—and provides space for inspector's initials.

Something new in engineering services is offered by a Philadelphia concern known as the Template Reproduction Company. Classified under the name of Precision Lofting, the service involves the reproduction on metal sheets or other materials of full-size detail drawings provided by the customer. The company also trains personnel in a manufacturer's plant to do the work.

Three metal-spraying processes for specific purposes have been announced by the Metallizing Engineering Company under the general trade name of Metcolizing. One, No. 11, applies aluminum, which is followed by a heat sealer and heat treatment, during which the aluminum is absorbed by the parent metal to oxidize later on its surface. This coat provides protection against heat up to 1600°F. and against attack by sulphur gases. Process No. 33 calls for chromium-nickel alloy topped by aluminum. Metal so treated will resist attack by strong gases in a temperature range up to 1800°. The third, No. 45, is a combination of three applications and is designed as a protection against tem-

peratures above 1800°. First comes a heavy layer of chromium-nickel, then one of aluminum, and last a heat sealer. All are primarily intended to make equipment such as furnace parts, burner caps, annealing trays, carburizing boxes, melting pots, etc., more heat-resistant.

Another war material now available to industry is a metallic packing designed by Johns-Manville for the purpose of sealing connections in exhaust systems of supercharged aircraft engines. It is made of Inconel—an alloy of nickel, chromium, and iron—in wire form. This is knitted into a narrow mesh and braided, sometimes with asbestos fibers, into tape or thick strips that can be cut to make ring-type gaskets for high-temperature service up to 2000°F. The alloy is said to be highly resistant to corrosion, and to be resilient, nonscaling, and nonmagnetic.

An electric heater that looks like hose and coils like hose is being made by the H. & A. Mfg. Company. Of ceramic and steel construction, it is inclosed in a wire-wound casing and comes in varying lengths and diameters and in capacities from 15 to 20 watts per lineal inch. Temperatures up to 1000°F. can be maintained without damage to the element, it is claimed, and heat can be applied either direct or through the medium of clips or fixtures. The unit may be left exposed, coated with insulating cement, or sealed into an assembly. It has been developed primarily for heating pipes, melting pots, molds, and equipment of oddly shaped contours around which it can be laid as close together as requirements may demand.

Explosionproof batteries, which were designed by the Philco Corporation for war purposes, are expected to find application in plants exposed to a fire hazard and using industrial trucks for materials handling. For service of this kind, a series of batteries is usually placed in a housing to facilitate removal from a truck for recharging and replacement. Mounted on the new unit is a cylinder charged with compressed air, which is fed into the space between the batteries and the top of the casing. There it combines with the gases from the batteries and induces a flow through the chamber that exhausts to atmosphere. The air is admitted at a rate that insures the formation of a mixture that is so dilute as to be nonexplosive. Another safety feature is a handle on the lid of the housing by which all component parts of the unit are locked before a truck leaves the charging station. Upon its return for servicing they are unlocked simply by moving the handle to the "open" position, which also causes a switch to disconnect the battery electrically from the truck or truck motors.

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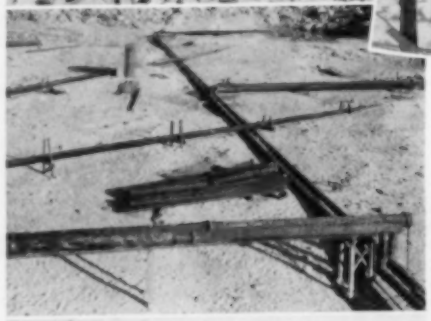

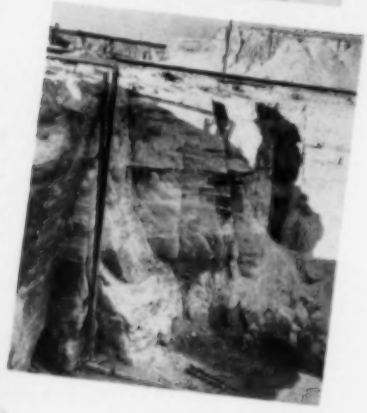

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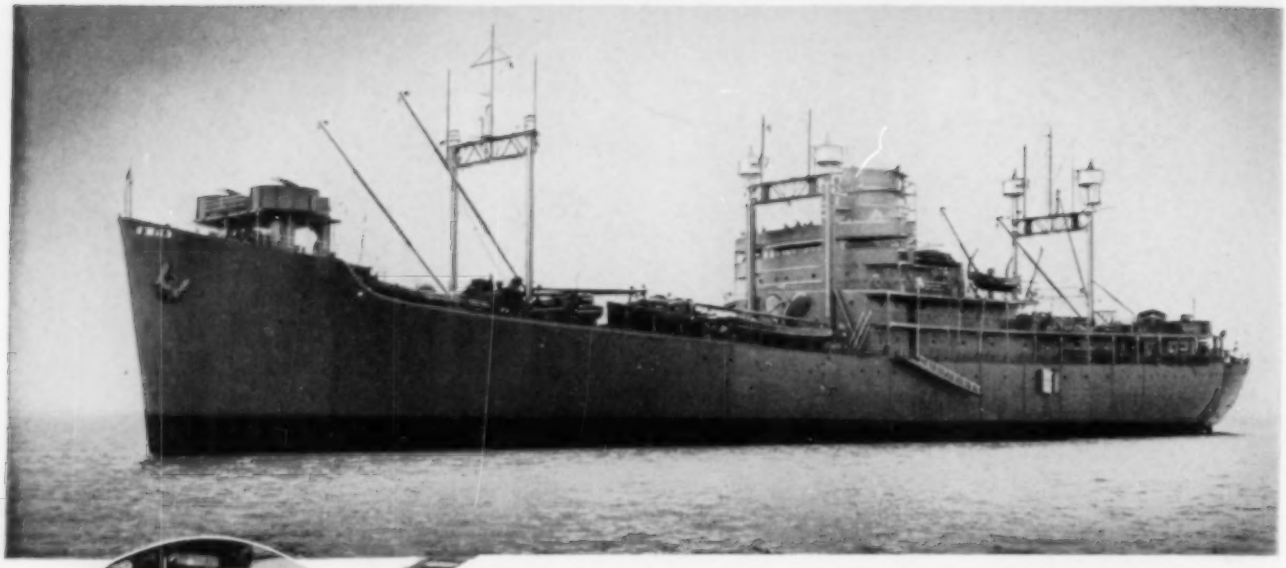

ALL IN THE SAME BOAT

Official U. S. Navy Photo

Official U. S. Navy Photo

The services performed by the Submarine Tender U.S.S. Pelias call for auxiliary power far above that required for most vessels of this size—and it must be dependable power. For this duty there are six Ingersoll-Rand Type "S" Diesel generator sets totaling nearly 2000 kw. Here is the power for the ship's machine shop, for its electric heat-treating furnaces, for battery charging, for this ship's galley, and for countless other purposes requiring electricity on a Submarine Tender.

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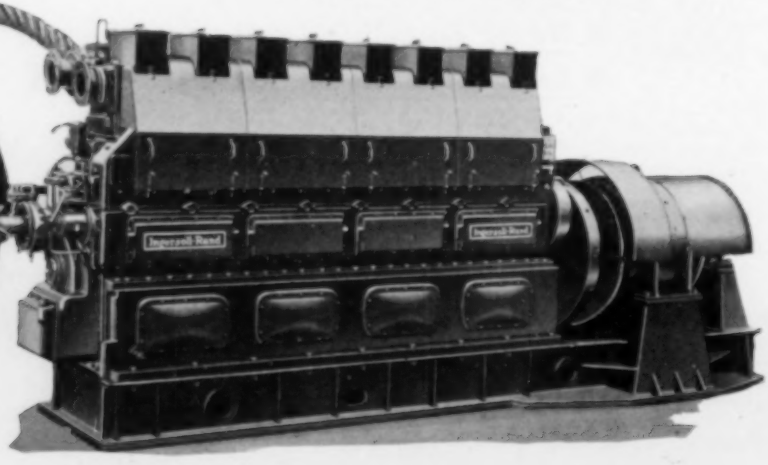

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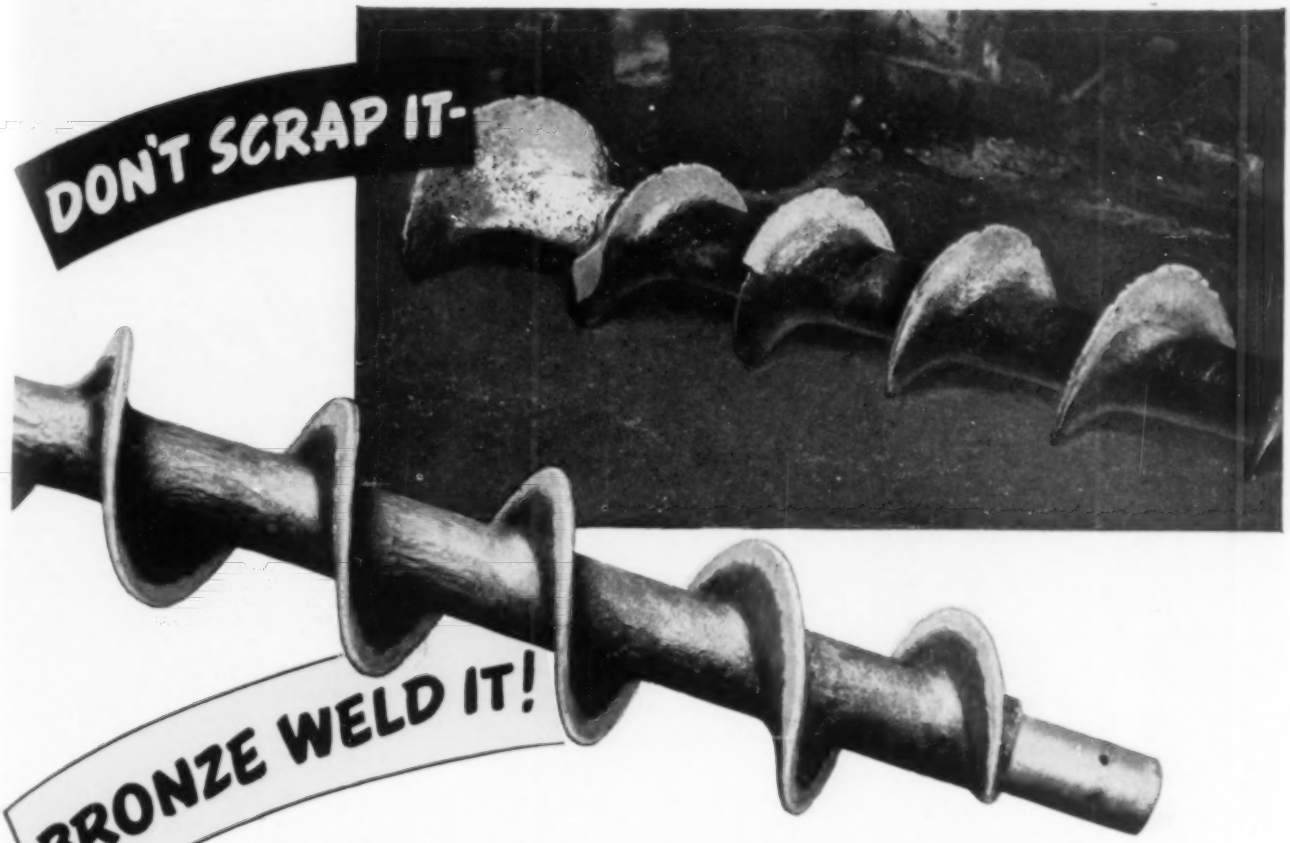

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Here's the answer to how, when and why...

The American Brass Company pioneered in the development of Bronze Welding and has a suitable rod for almost every gas or electric Bronze Welding purpose. Anaconda Publication B-13 describes these rods and suggests procedures for their use. A copy is yours for the asking.

It's hard to imagine any kind of industrial equipment taking a worse beating than a spiral feed screw. Under tons of wet coal or in a hot ash pit, corrosive and abrasive action are ever-present. To a well known mid-western railroad shop, continual replacement because of worn outer edges proved not only too expensive but unnecessary. Bronze Surfacing was found to be fast—and far more economical.

Welding rods such as "997" Low-Fuming and Tobin Bronze* are extensively used with the oxy-acetylene torch to deposit high strength, dense and tough weld metal on cast iron, malleable iron, steel and copper alloys. By this building-up process many shops are daily saving countless dollars by reclaiming worn parts and industrial equipment:—Sheaves, pulleys, bushings and bearings, pistons, impellers and pump parts, stripped threads and broken gear teeth, thrust plates, hubs, flanges, parts machined undersize, etc.

In addition, low temperature Bronze Welding offers a ready means of repairing broken or fractured production equipment and machine tools. Next time, "Don't Scrap It—Bronze Weld It!"

*Reg. U. S. Pat. Off.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut • Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

4492

ANACONDA
from mine to consumer

Anaconda Bronze Welding Rods

IT TAKES JUST SIX STURDY PARTS TO MAKE A STRONG *Walco* WRENCH

Each of the six parts that make up a Walco wrench is designed to provide maximum strength, safety, and ease of operation. ***All parts are made entirely of steel.*** Handle and both jaws are drop forged steel, heat treated by precision methods to assure strength, toughness and uniformity.

Each part is replaceable including the exclusive Walco renewable lower jaw. This makes the Walco easy to maintain and good for an indefinite span of service—no matter how severe the service or how heavy the abuse.

Thousands of users prefer the Walco as the safest, strongest, most useful pipe wrench made. The Walco wrench is a product of the Walworth Company, manufacturers of valves, fittings and tools for over a century.

The Walco wrench is made in lengths of 6″—8″—10″—14″—18″—24″—36″—and 48″. The 6″ and 8″ sizes have integral lower jaw.

BOSTON WORKS
KEWANEE WORKS

WALWORTH
valves AND fittings

WALWORTH ★ VALVES AND FITTINGS ★ ESTABLISHED 1842

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

THINKING OF BUYING A NEW AIR COMPRESSOR?

If so, don't buy merely an anti-frictionized compressor; buy a *Timken Bearing Equipped* compressor and thus be sure of getting anti-friction advantages *in full.*

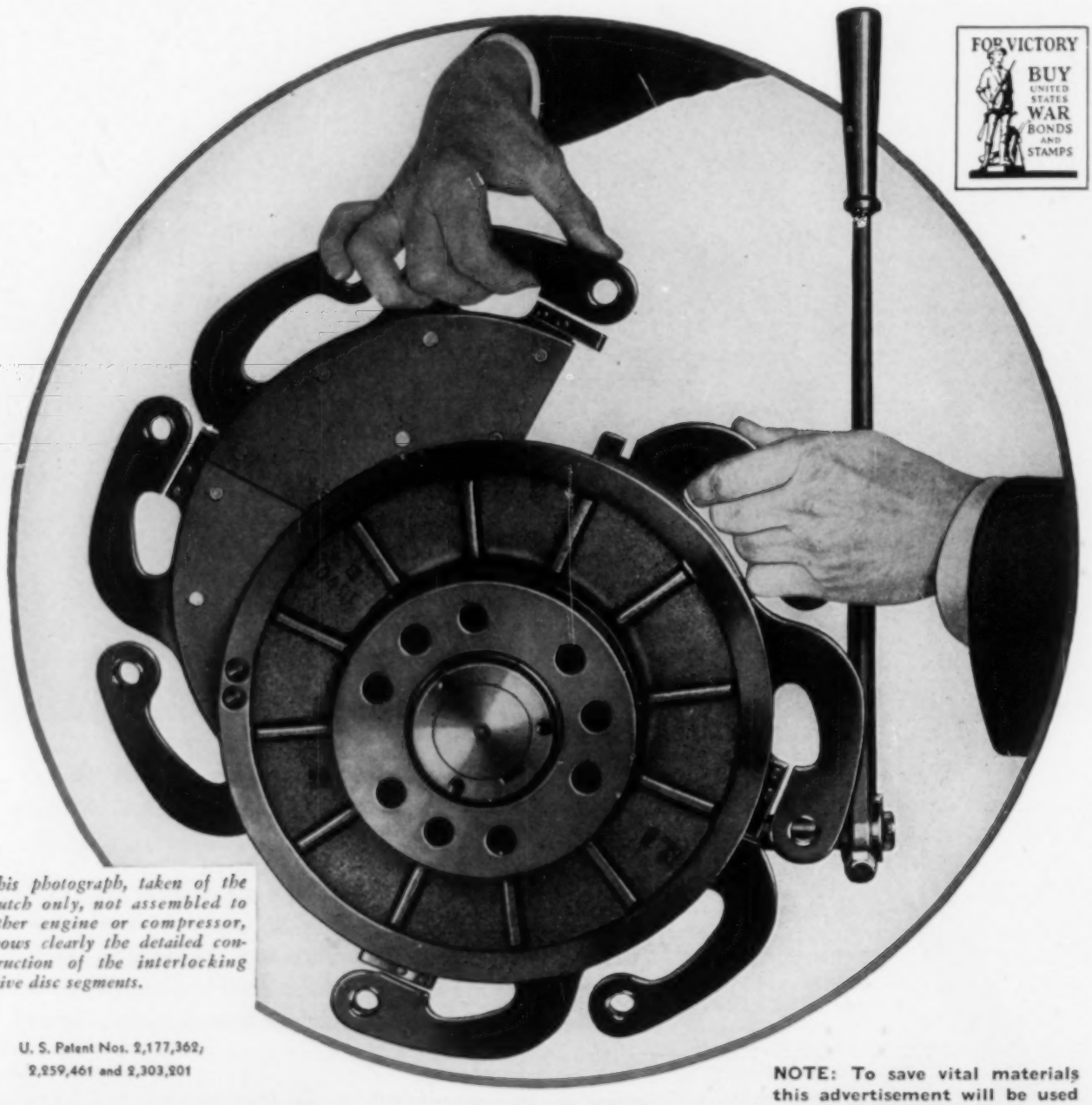
With Timken Tapered Roller Bearings on your compressor crank shafts you will get not only smooth, frictionless operation, but greater endurance and economy as well; for Timken Bearings prevent crank shaft wear, preserve crank shaft alignment and protect it against radial, thrust and combined loads.

Shown in the photograph is an Ingersoll-Rand IK-315 Mobil-Air Compressor equipped with Timken Bearings, supplying power to an Ingersoll-Rand FM-2 Wagon Drill —also equipped with Timken Bearings—and Ingersoll-Rand JB-5 Jackhamer, all working on the construction of a reservoir in New England. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

FLEX-DISC CLUTCHES

Used on the entire line of I-R *Mobil-Air* Compressors, have a time proven drive disc with flexible fingers solidly bolted to the fly wheel. When the friction facings become worn these drive discs, which are quickly detachable in segments, may be removed and relined or replaced without disconnecting the engine from the compressor.



FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

This photograph, taken of the clutch only, not assembled to either engine or compressor, shows clearly the detailed construction of the interlocking drive disc segments.

U. S. Patent Nos. 2,177,362; 2,259,461 and 2,303,201

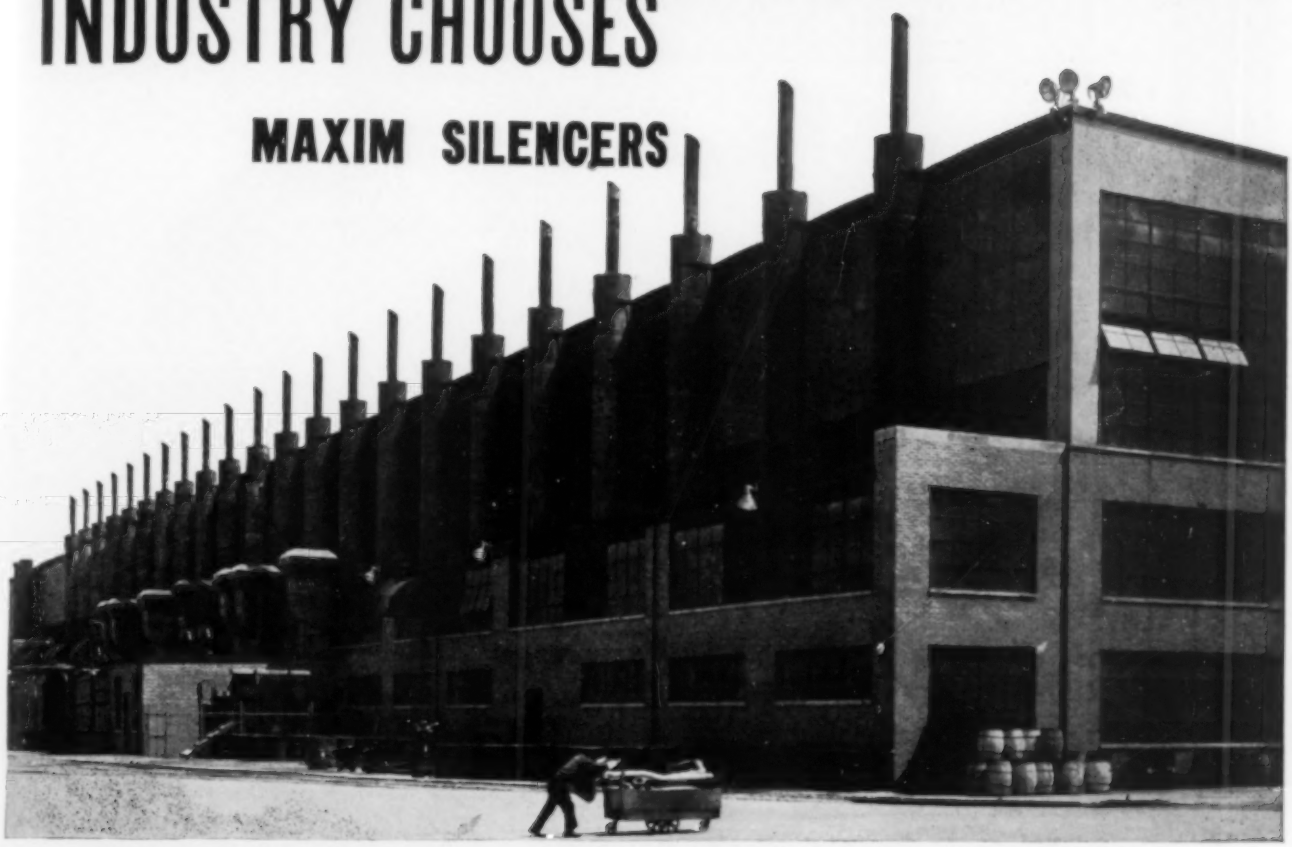
NOTE: To save vital materials this advertisement will be used for "the duration."

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

INDUSTRY CHOOSES

MAXIM SILENCERS



FOR THREE PRACTICAL REASONS

- **EXPERIENCE**

  Maxim, conservatively the greatest name in silencing, has become so because of many years of research and practical experience in this field. Today's Maxim Silencers give users the advantage of this greater experience in development and manufacture of silencing equipment.

- **PERFORMANCE**

  Thousands of installations in many branches of industry give adequate proof of Maxim performance. With many types to select from, the right silencer for the specific installation is carefully chosen and, if necessary, special equipment is designed so that superior performance is assured.

- **ADAPTABILITY**

  Maxim Silencers cover a line so varied that it is seldom necessary to go beyond the standard silencers to get a job "tailor-made" for your installation. No silencer, however good, can do the best job unless it is totally adapted to your particular installation. The flexibility of Maxim's standard silencers line is an important advantage to the buyer.

INDUSTRY CAN

SAVE FUEL

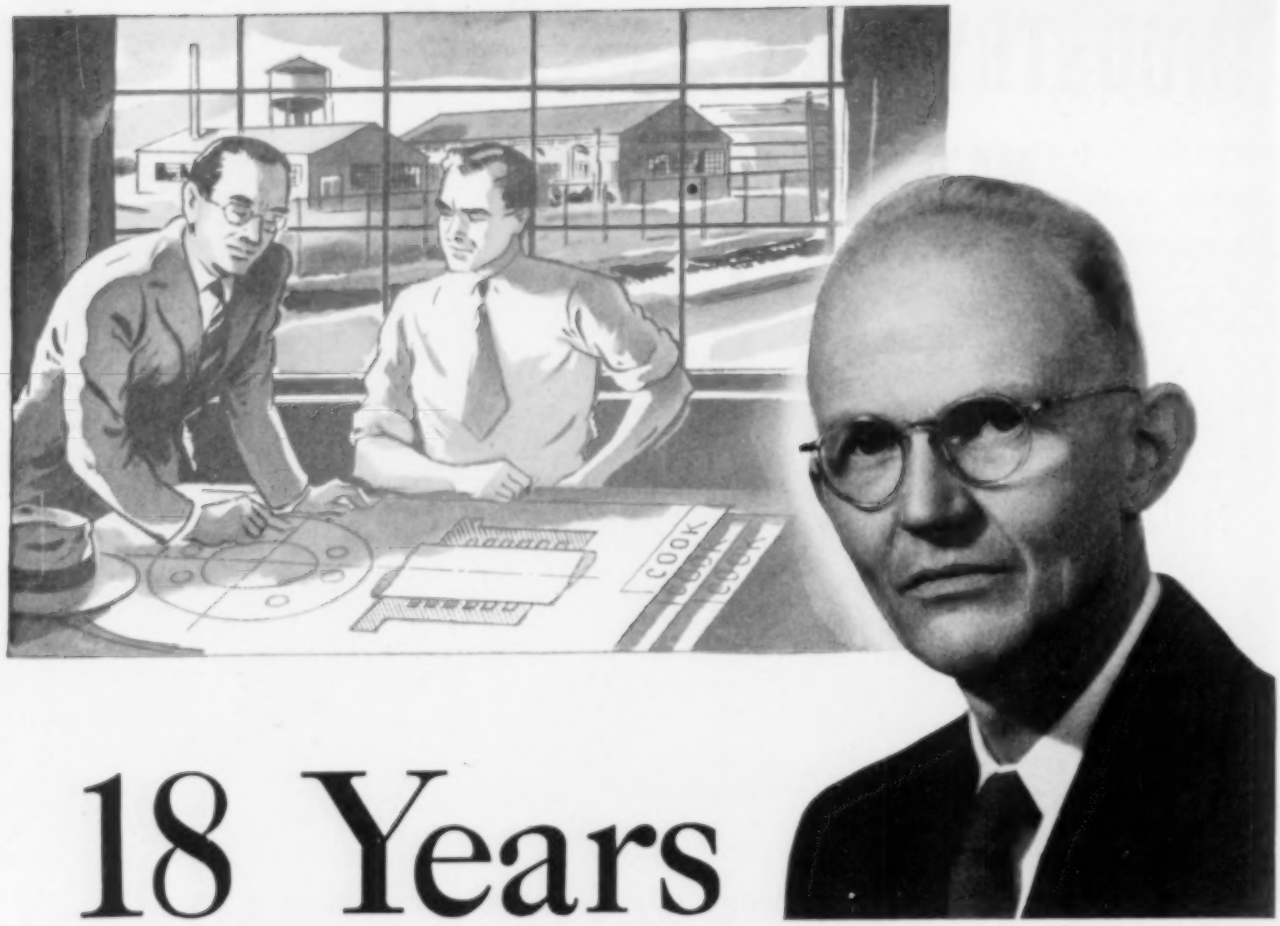
WITH MAXIM HEAT RECOVERY SILENCERS . . . . . .

Maxim Heat Recovery Silencers make use of engine exhaust heat, normally wasted, to produce steam or hot water for heating or processing operations. This is done without the use of any *extra* fuel except that normally used in engine operation. Send for Maxim Heat Recovery Silencer Bulletins WH-100, WH-101, WH-102, WH-103.

ARMY (E) NAVY

THE MAXIM SILENCER COMPANY
85 HOMESTEAD AVENUE • HARTFORD, CONN.

MAXIM



18 Years

of Service to the users of Cook's Packings and Piston Rings

SOME ONE has said a product is only as good as the service behind it. This particularly holds true in the case of Rod Packing and Piston Rings because there are so many operating variables attending each application over which the manufacturers of these products have no control. We feel, therefore, that the wide preference given Cook's Metallic Rod Packings and Piston Rings, in no small way, has resulted from the calibre of our field representatives.

In California we have been unusually fortunate in having our oil field activities in the hands of Morgan Washburn during the past eighteen years. We feel this so strongly, we are taking this means of publicly commending him on the fine job he has done. We believe his host of friends share this feeling also, and that they too, join us in wishing him continued success and good health.

Capable, honest, sincere and thorough, Morgan Washburn would be a credit to any organization. He is the kind of man we like to have represent us. We have plenty of evidence he is the kind our customers like to deal with.

Sealing Pressures — Since 1888

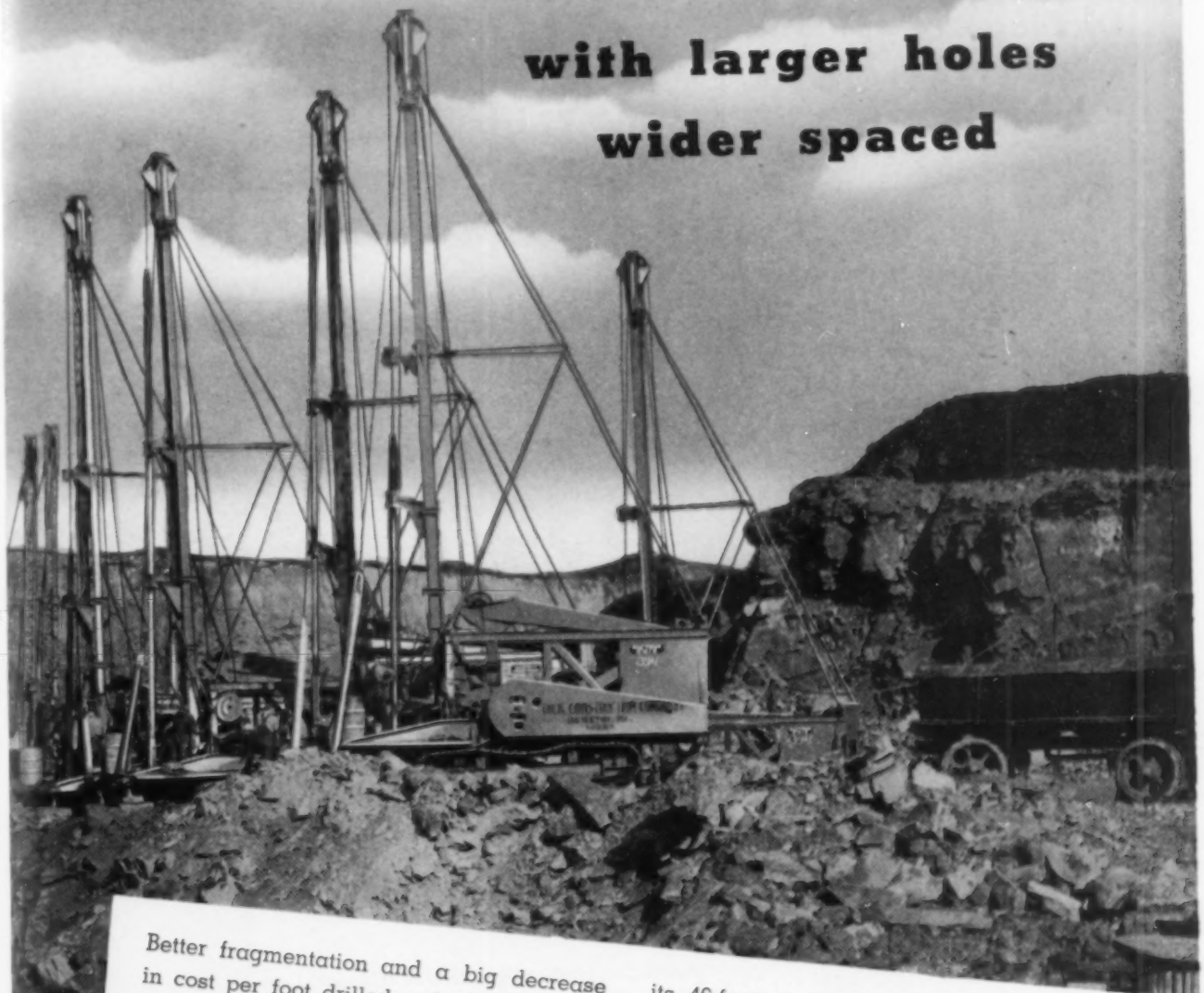
C. LEE COOK MANUFACTURING CO. INCORPORATED

LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

CUT PREPARATION COSTS

with larger holes wider spaced



Better fragmentation and a big decrease in cost per foot drilled — that's a big reason why many strip mine operators are swinging to the large 9-inch to 12-inch holes drilled with the Bucyrus-Erie 42-T. Easier to load than small holes and having much greater powder capacity, the larger, wider spaced holes mean less drilling per yard of bank prepared and more yardage per move and setup.

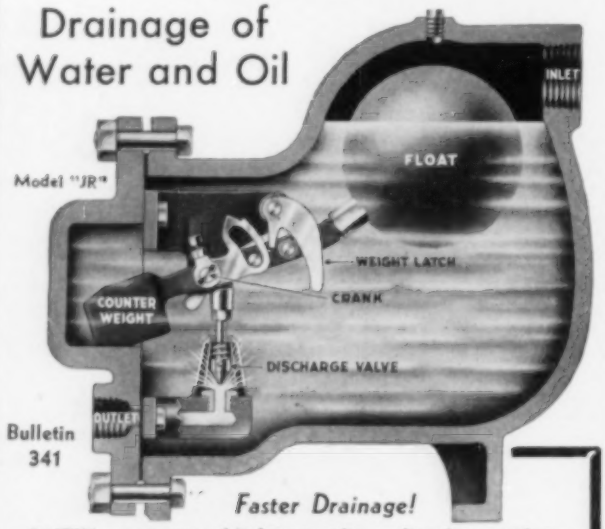
It takes a big, powerful drill like the 42-T to put down the large diameter holes. With its 46-foot derrick, its rigid construction, high speed drilling action, and fast sharp upstroke, the 42-T swings up to 6,000 pounds of tools . . . and puts down large diameter holes as rapidly as other machines drill 6 to 8-inch holes.

It's easy to take advantage of the increased tonnage and decreased drilling costs that come with larger holes. Write for details on the blast hole drilling economy that will be yours with the 42-T.

H-52C

SO. MILWAUKEE **BUCYRUS ERIE** WISCONSIN

A Compact Compressed-Air Trap
FOR
AUTOMATIC
Drainage of
Water and Oil



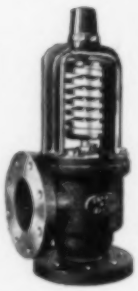
Bulletin
341

Faster Drainage!

FASTER! . . . because of its large capacity. . . its weight-operation, giving full positive action . . . its rapid intermittent opening and closing. Welded stainless steel float. Water-sealed discharge valve.

W. H. **NICHOLSON** & CO.
180 OREGON ST., WILKES-BARRE, PA.
Valves ★ Traps ★ Steam Specialties

HIGH LIFT



A FEATURE OF *EVERY*
FARRIS
RELIEF VALVE

Open or enclosed spring liquid relief valves. Sizes: ¾" to 6" in steel, semi steel and bronze; pressures to 600 p.s.i.

High lift . . . which means prompt relief . . . is provided by the oversize springs in Farris Relief Valves.

Moreover, these springs have low fibre stress . . . low pitch . . . are mounted on flexible joints at both upper and lower points . . . and are carefully calibrated.

These are some of the features that give you dependable operation, long life, and low maintenance expense. Write for bulletin and complete information.

FARRIS ENGINEERING COMPANY
354 Commercial Ave. **Palisades Park, N. J.**

BUY ALL THREE FOR ONLY $6.00
or Any COMBINATION at PROPORTIONATE SAVINGS

COMPRESSED AIR DATA (Fifth Edition): 408 pages on the theory and practice of compressed-air engineering.

CAMERON HYDRAULIC DATA (Eleventh Edition): 240 pages on hydraulics, water data, miscellaneous liquids, steam data, electric data, and miscellaneous data.

CAMERON PUMP OPERATORS' DATA (First Edition): 170 pages of practical information for the man who installs, operates or services centrifugal pumps.

Fill out the coupon and mail it today. Be certain to check the group of books wanted.

COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey, U. S. A.
Please send me:

- ☐ Compressed Air Data, Cameron Hydraulic Data and Cameron Pump Operators' Data ..... All three for $6.00.
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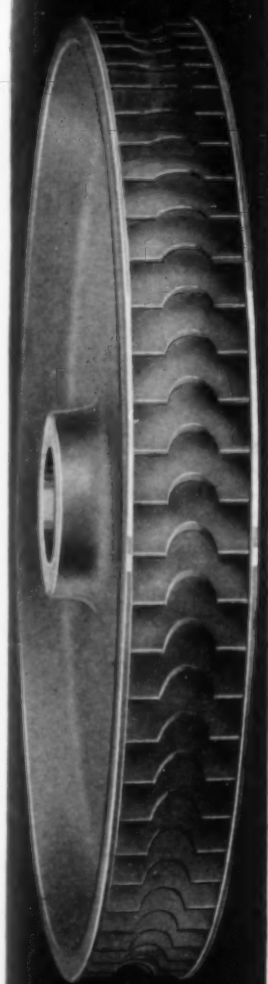
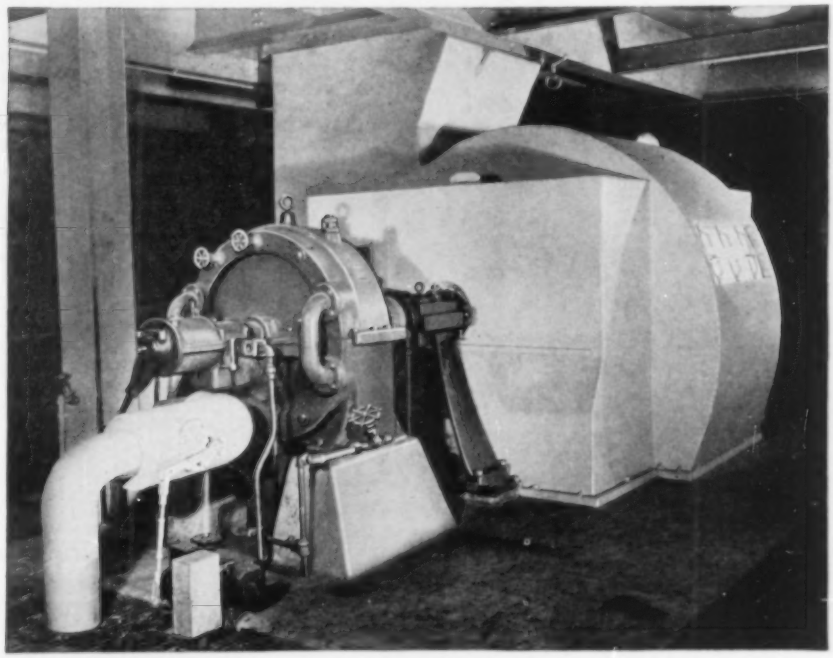
- ☐ Enclosed is (money order) (check) for $.....) ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

Name .....
Company .....
Street No. .....
City ..... State ..... Country .....

TERRY





BUCKETS AND ROTOR IN THE TERRY WHEEL TURBINE

. . ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel. There are no parts to become loose or work out. Such construction makes for long life and low maintenance.

This and many other features of Terry Wheel Turbine design are described in our Bulletin S-116. A request on your business letterhead will bring a copy.

ABOVE: 250 H. P. Terry Wheel Turbine driving Induced Draft Fan. Unit is one of ten Terrys installed in a mid-western plant.

T-1153

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Specify NOPAK for LONG VALVE LIFE

The two packaging press "veterans" are similar in design and construction to the modern 3-and 4-Way NOPAK Hand Operated Valve shown in the circle.

OVER 10 YEARS CONTINUOUS SERVICE WITHOUT MAINTENANCE EXPENSE

The two NOPAK ¼", 3-Way Air Valves on the packaging press shown above, have been in daily use for over ten years without a single day off for repairs or maintenance. After 10 years they are still leak-proof, show no visible signs of wear.

This is the kind of long term, maintenance-free operation you can expect from NOPAK Valves. It is the inevitable result of the patented cored-disc principle, hand-lapped, wear-proof disc and seat, shielded sealing surfaces, packless valve stem assembly . . . features which contribute to their simplified design and extremely rugged construction.

You can specify NOPAK Air or Hydraulic Valves for the precision control of cylinder power movements in your plant, with absolute confidence in their dependability, long service-life and low maintenance costs.

Write for Bulletin 88.

GALLAND-HENNING MFG. CO.
2759 S. 31st STREET MILWAUKEE 7, WISCONSIN

NOPAK *Representatives in Principal Cities*
VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE

A 4553-½R

New Model A-1 Pur-O-fier

For Compressed Air

Positive purification of air lines is assured with this new Model A-1 Pur-O-fier designed to eliminate free moisture, oil and foreign matter in small compressed air systems. It operates with from 1 to 5 cubic feet of air and for intermittent operations is extremely sensitive to the slightest movement of air. Weighing only 1¼ lbs., this new unit is just 3⅛" in diameter by 5⁹⁄₁₆" deep including plastic, transparent entrainment sump. Model A-1 Pur-O-fier requires no maintenance.

Drain valve permits easy and quick draining of the sump. Pur-O-fier uses positive, centrifugal action as a medium for purification and can be used for air-operated instrument controls, air-operated gauges of the precision and checking type, and air-operated cleaning devices of many types. This unit will operate effectively from 1 to 75 P.S.I. Write for bulletin No. 11 giving complete details.

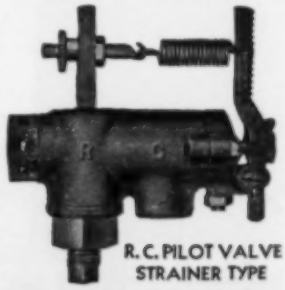
Patent applied for

Write for New Bulletin No. 11 giving complete specifications and applications

BIRD-WHITE COMPANY
3120 WEST LAKE STREET
CHICAGO, ILLINOIS

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors . . . installed as replacements on thousands of compressors in all parts of the U. S. A. and overseas. The R-C valve—positive in action—cannot chatter . . . it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.

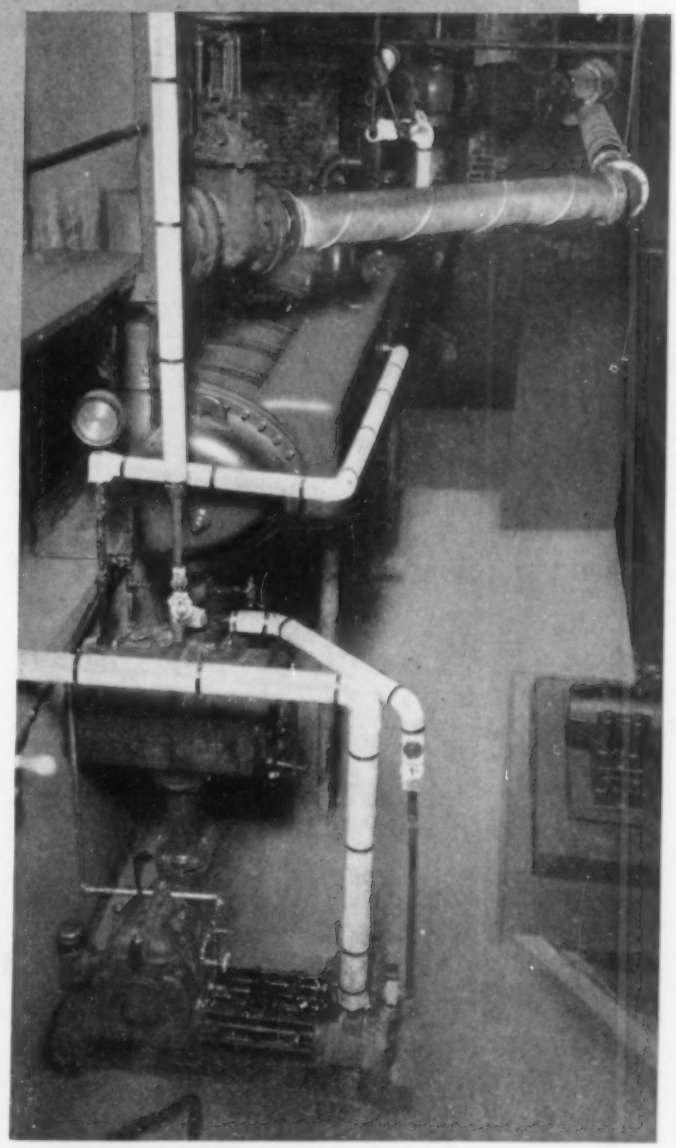


R. C. PILOT VALVE STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

Installed in 1928

Another in 1940



This condenser, installed in 1928, serves a steam engine and also heats circulating water used in a washing process. A constant hot water temperature is maintained by suitable controls. The operation of this plant was so satisfactory, that a duplicate condenser was installed in 1940 in another one of the customer's plants.

Today—with a heavy war-time production job to do—both of these units are serving at top efficiency.

Ingersoll-Rand has a complete line of vacuum-producing equipment—surface and barometric condensers, steam-jet ejectors, and reciprocating vacuum pumps. This equipment has proved its reliability for application to prime movers and other vacuum equipment. Ask our representative for complete details on this equipment and also on pumps, compressors, maintenance tools, etc.

Ingersoll-Rand

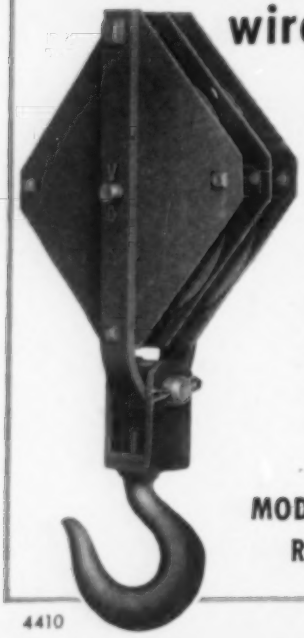
11 BROADWAY, NEW YORK 4, N. Y.

4-508

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

AMERICAN

wire rope blocks



Standard Duty

For average work which includes most of the service in industry and construction.

Heavy Duty

For extremely heavy construction and erection work.

MODERN DESIGN
RUGGED CONSTRUCTION

4410

AMERICAN HOIST & DERRICK CO.
SAINT PAUL 1, MINNESOTA
CHICAGO SAN FRANCISCO NEW YORK

THE GENUINE *Crosby Clip*
WHEREVER WIRE ROPE IS FASTENED

You Don't Buy Trouble With This Air Cleaner!

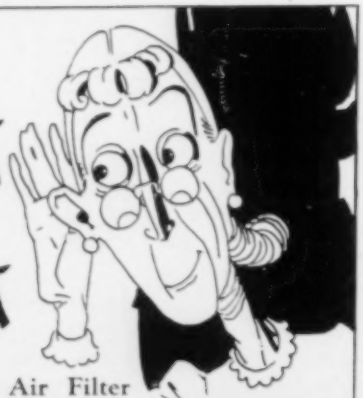
Busy plants prefer the Aridifier because it not only thoroughly removes moisture, oil and dirt from compressed air, but also functions indefinitely with a minimum of attendance. With the Aridifier — which employs centrifugal force to remove contamination — all that need be done is to empty the trap periodically. There are no filters, bags or other elements which require frequent cleaning and which generally operate at progressively decreasing efficiency.

Aridifiers are available in sizes for $\frac{3}{8}$" to 10" pipe. Ask for Bulletin 543.

Logan Engineering Co.
4911 Lawrence Ave., Chicago 30, Ill.

Logan ARIDIFIER
Dries and Cleans Compressed Air

ON THE ALERT FOR DIRT



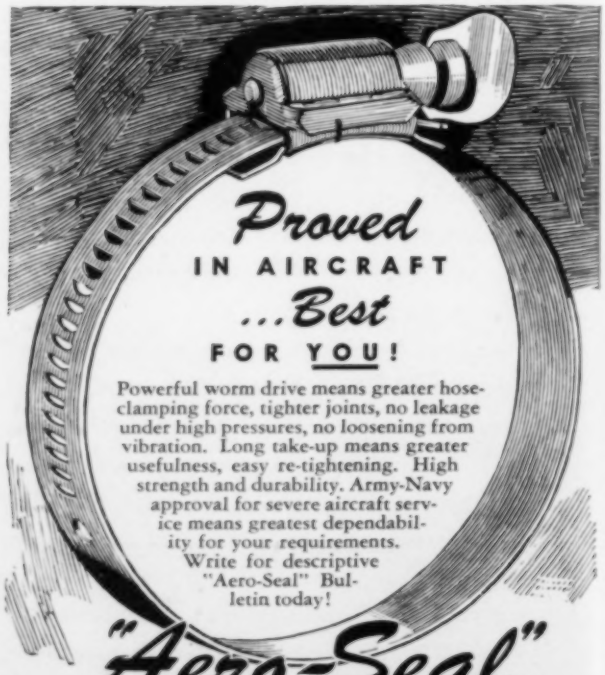
Let a Norgren Air Filter guard your air driven equipment and tools. Simple and compact. A double Monel wire screen eliminates grit and dirt, moisture and oil emulsions, from air lines.

Easy to clean—open the pet cock —blow it out.

Essential in all pneumatic installations.

Write C. A. Norgren Co., 220 Santa Fe Drive, Denver 9, Colorado, for detailed information and prices.

Norgren



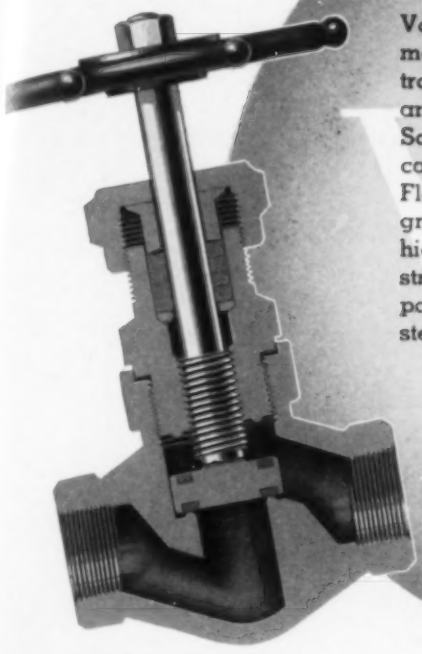
Proved
IN AIRCRAFT
...Best
FOR YOU!

Powerful worm drive means greater hose-clamping force, tighter joints, no leakage under high pressures, no loosening from vibration. Long take-up means greater usefulness, easy re-tightening. High strength and durability. Army-Navy approval for severe aircraft service means greatest dependability for your requirements. Write for descriptive "Aero-Seal" Bulletin today!

"Aero-Seal" HOSE CLAMPS

AIRCRAFT STANDARD PARTS CO., 1771 19th AVE., ROCKFORD, ILL.

DROP FORGED STEEL AND SEMI-STEEL VALVES FOR ICE MAKING AND REFRIGERATING PLANTS!



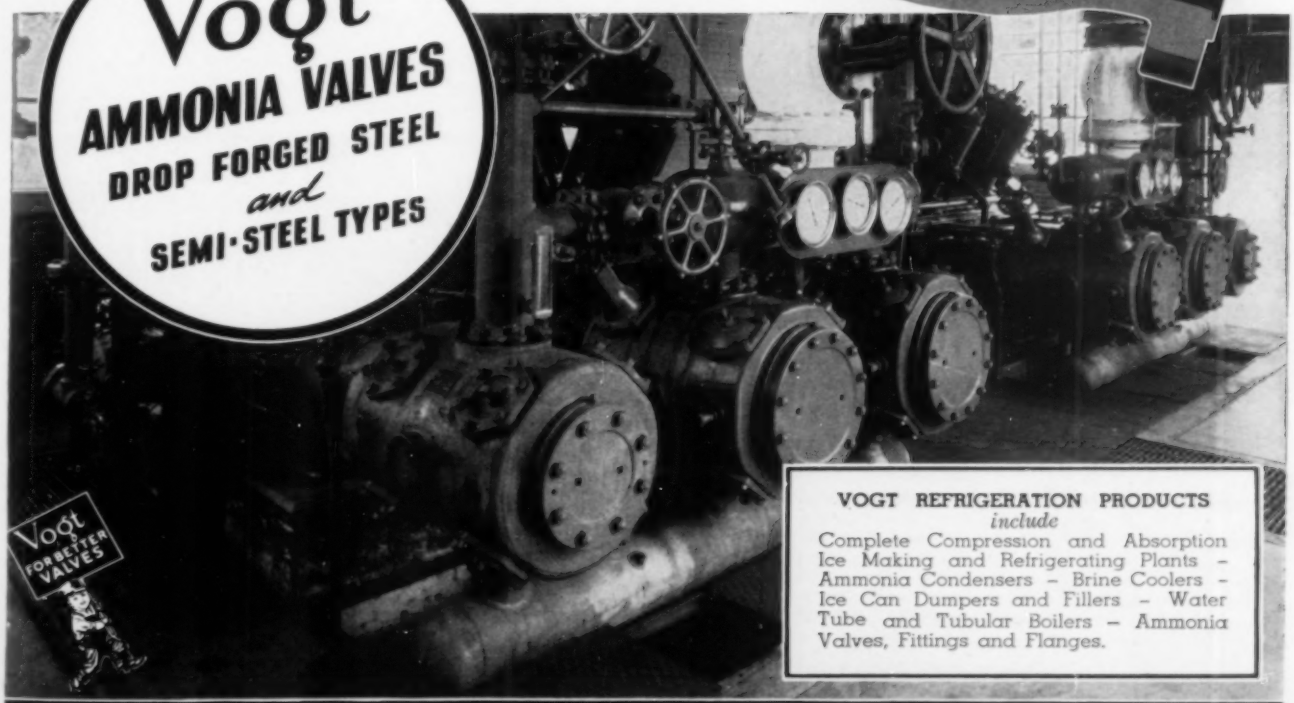
Vogt builds a complete line of ammonia valves for the positive control of refrigerants in ice making and refrigerating plants.
Screw end valve bodies are fabricated from solid steel drop forgings. Flanged bodies, with tongue and groove facings, are cast from a high grade semi-steel for maximum strength and tightness. All companion flanges are drop forged steel.

Catalogue AF-2 covers our complete line of Ammonia Valves, Fittings and Flanges.

(*Right*) Flanged Globe and Angle Valves from ¼" to 10" inclusive.

(*Above*) Screw End Globe and Angle Valves from ¼" to 2" inclusive.

Vogt
AMMONIA VALVES
DROP FORGED STEEL
and
SEMI-STEEL TYPES



VOGT REFRIGERATION PRODUCTS
include
Complete Compression and Absorption Ice Making and Refrigerating Plants – Ammonia Condensers – Brine Coolers – Ice Can Dumpers and Fillers – Water Tube and Tubular Boilers – Ammonia Valves, Fittings and Flanges.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE, KY. *New York - Philadelphia - Cleveland Cincinnati - St. Louis - Chicago - Dallas*

Marine PRESSURE SWITCHES

DRIPPROOF AND WATERTIGHT HIGH SHOCK CONTACT BLOCK—TWO OR THREE POLE—CLASS 9013 TYPE AW-H, MW-H, LW-H

ELECTRICAL RATINGS

Voltage	Single Phase A.C.	Polyphase A.C.	D.C.
110V.	2 H.P.	3 H.P.	1 H.P.
220V.	3 H.P.	5 H.P.	1 H.P.
440-550	5 H.P.	5 H.P.	.....
32V.	.....	.....	½ H.P.

● Built for Marine Service to conform with requirements for dripproof and watertight devices of shockproof construction. The switches differ from standard in the use of a special sheet steel enclosure and drip hood with gasket seal and a special high shock bakelite contact block in two or three pole form. The three types AW-H, MW-H and LW-H represent three diaphragm sizes and three range and differential variations. A release valve for air compressor service may be added to any of the types, as illustrated. Write for Bulletin 562.

REGULATOR DIVISION
SQUARE D COMPANY
DETROIT • MICHIGAN

There Is No Compressed Air Condition So Bad In Any Factory That We Cannot Correct and Completely Remedy

WATER removed from AIRLINES AUTOMATICALLY with the MURPHY SEPARATOR

SIZES ½" TO 4" PIPE

Literature and Prices on request

RESULTS - - - GUARANTEED
NO ABSORBENTS - NO CHEMICALS
AFTERCOOLERS - - - SPRAYERS

JAS. A. MURPHY & CO.
HAMILTON, OHIO

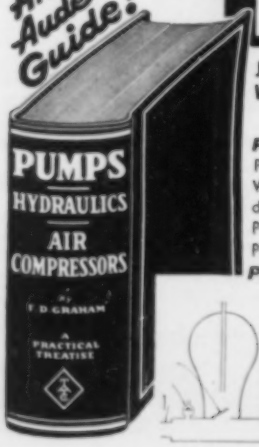
Specify WALDRON Flexible COUPLINGS

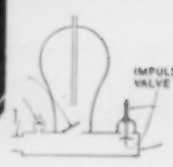
Compare their design with that of any other coupling. No welding in forged steel cover and sleeve. No flexible hub connections to fatigue. No leakage through positive Walflex Seal. No added stress on shaft or bearings while compensating for misalignment. By eliminating the chief causes of wear and repair, you insure longer trouble free service.

Catalog containing construction details, rating tables, etc. will be sent on request. No obligation.

JOHN WALDRON CORP.
Main Office and Works
New Brunswick, New Jersey
COUPLINGS

An Audel Guide!





PUMPS-HYDRAULICS-AIR COMPRESSORS

JUST OUT! 3 BOOKS IN ONE—OVER 1650 PAGES, 1654 ILLUSTRATIONS, WITH QUESTIONS AND ANSWERS. COMPLETE PRACTICAL CONCISE INFORMATION FOR ALL ENGINEERS AND OPERATORS.

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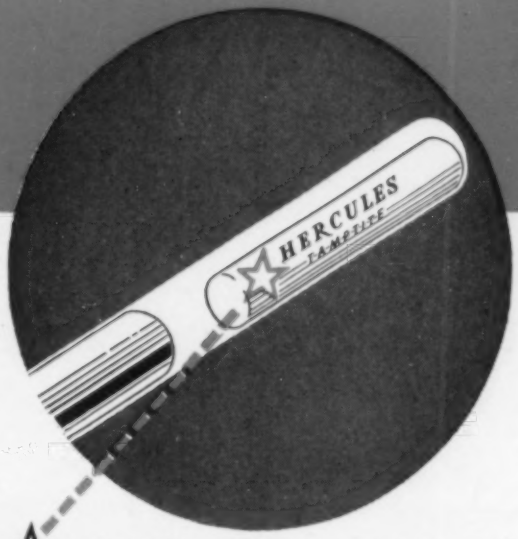

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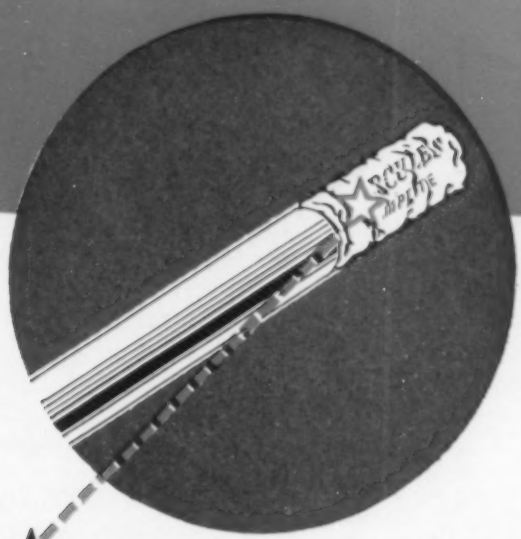

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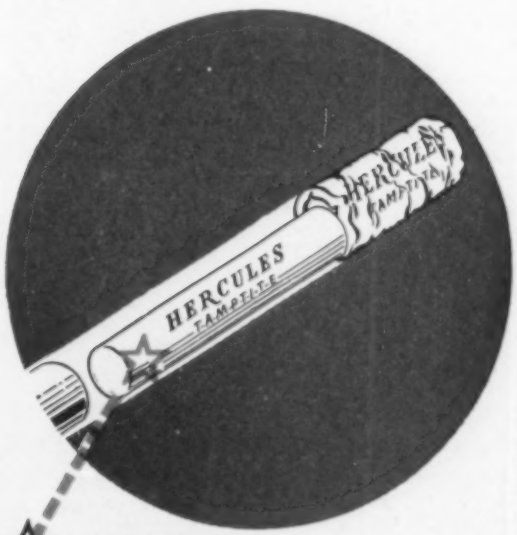

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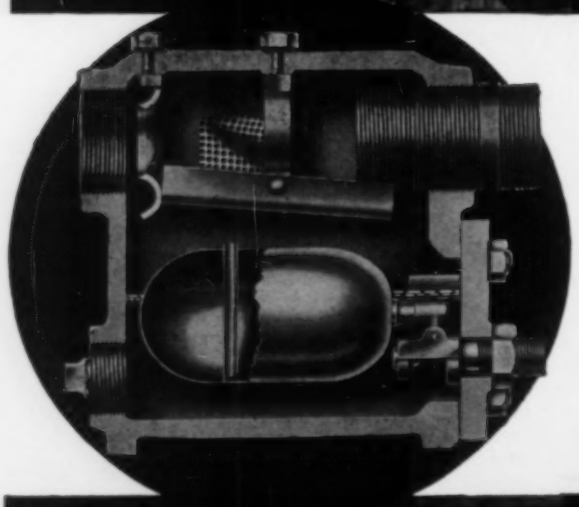

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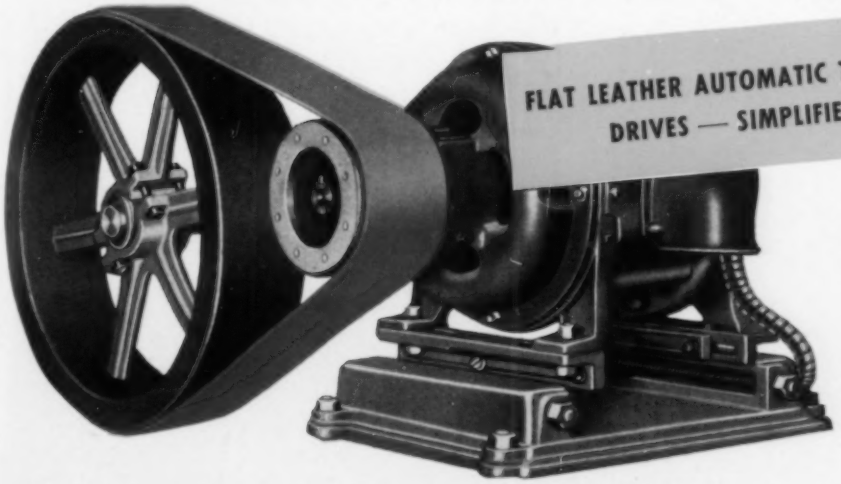

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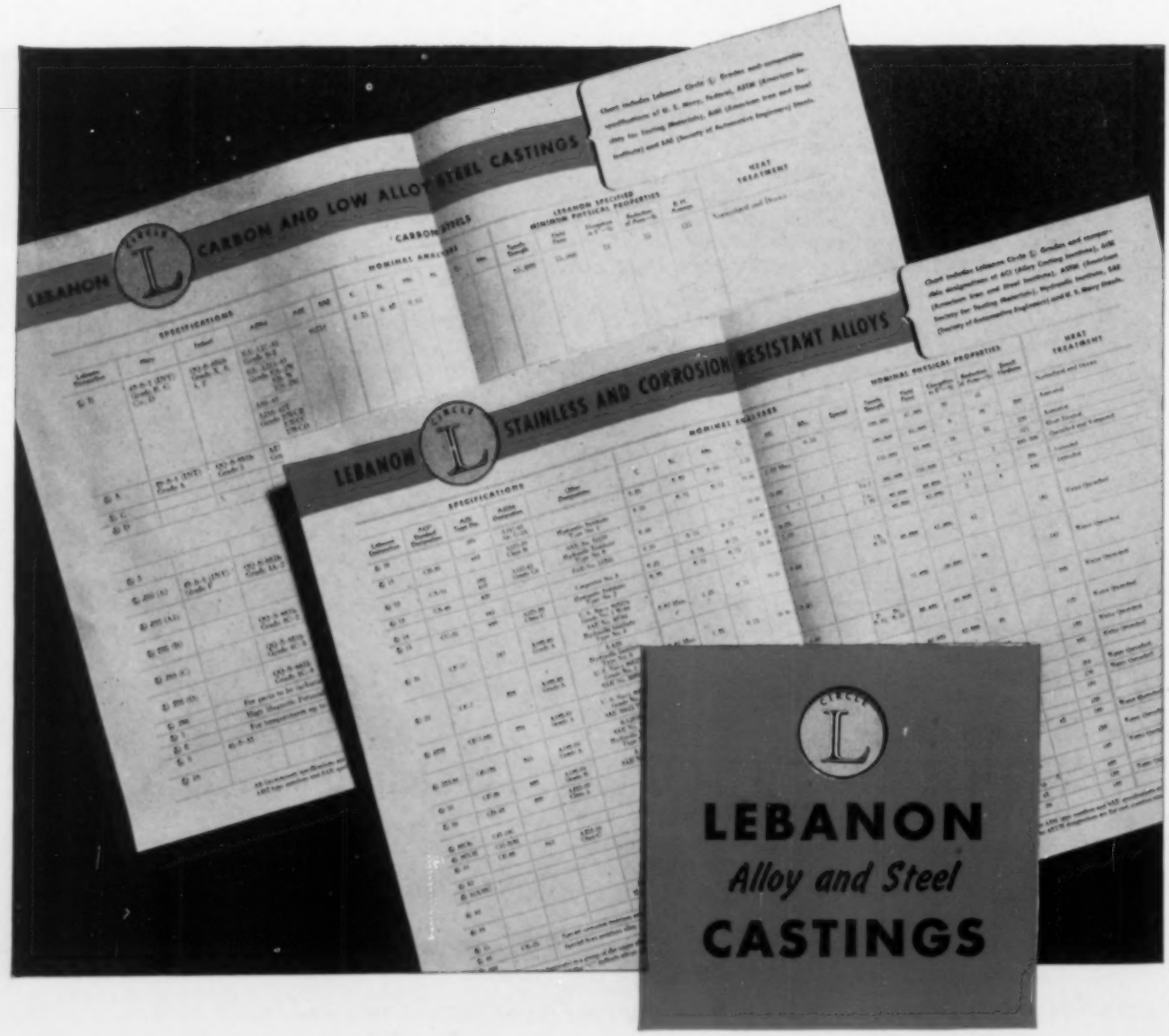
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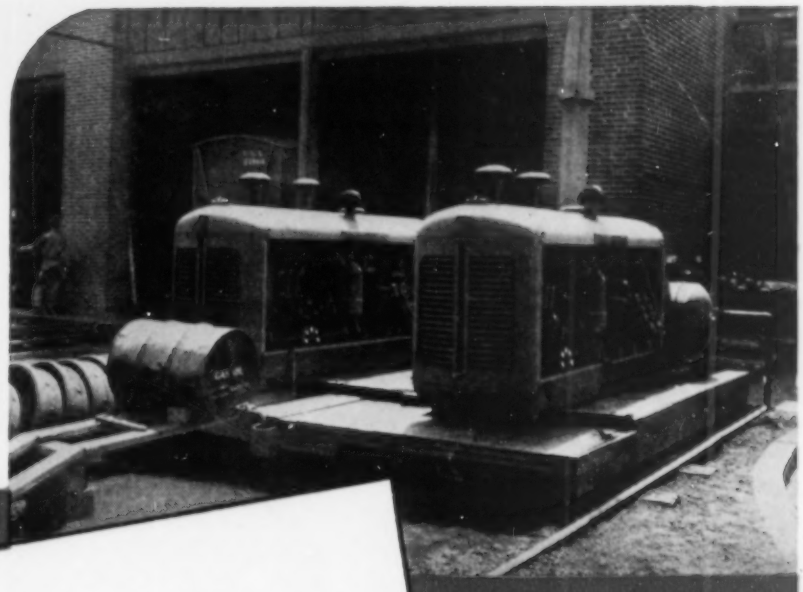

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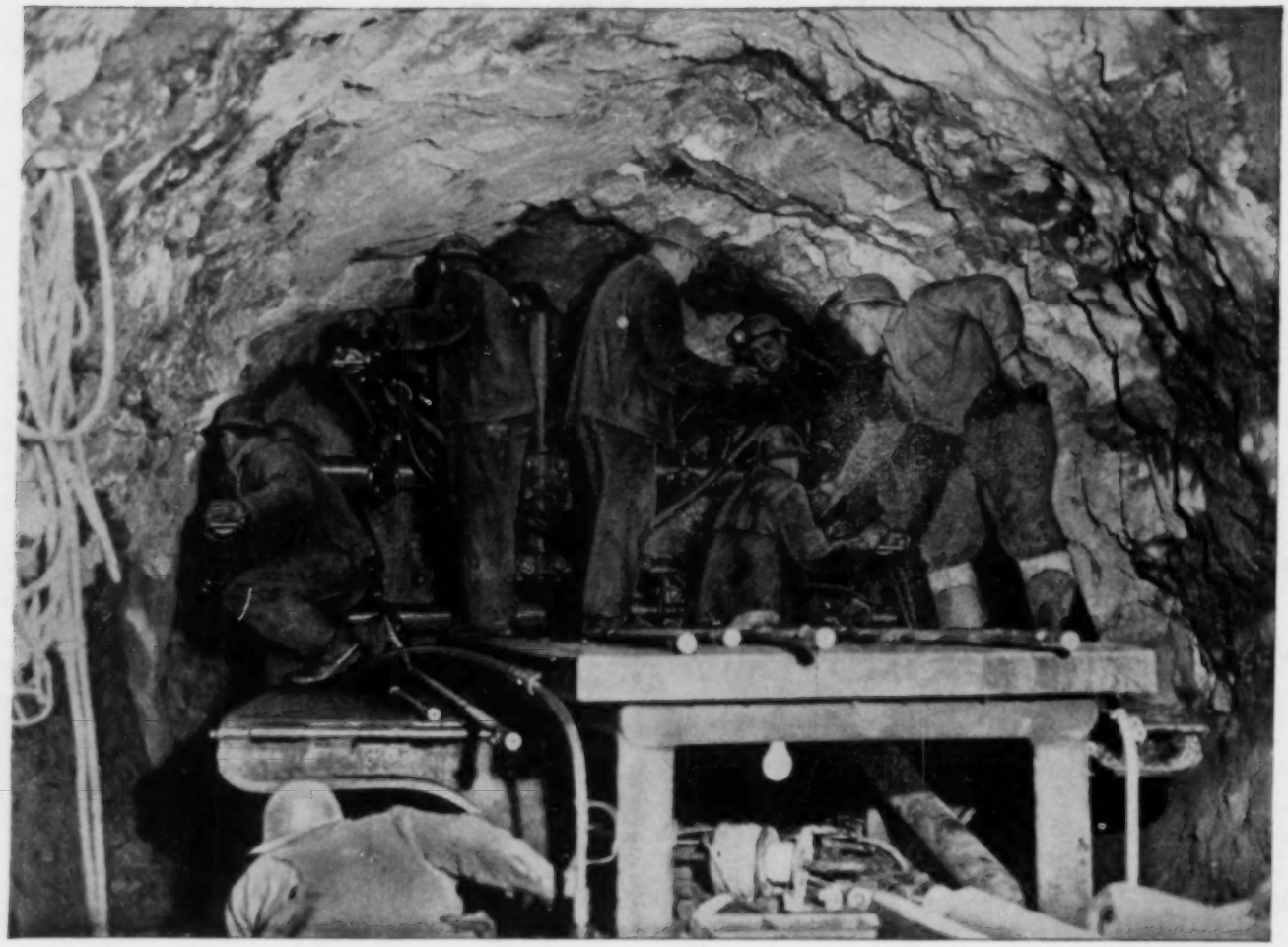

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